USER MANUAL

for installation and operation of automatic hot water boiler, utilizing dry calibrated wood chips

of series Pelletherm 30v2 BIO

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The boiler’s producer company requires the installer technicians, which will perform the installation, maintenance and service procedures of the boilers of series “Pelletherm 30v2 BIO” to be trained and certified by the producer.

NOTE: in the following document is used the designation “Pelletherm 30v2 BIO”, which refers to the hot water boiler “Pelletherm 30v2”**.**

ATTENTION!

IN INTEREST OF YOUR PERSONAL SECURITY IT IS OBLIGATORY TO READ THOROUGHLY AND CAREFULLY THIS INSTRUCTION MANUAL BEFORE PROCEEDING WITH ANY ACTIONS WITH THE BOILER – MOUNTING, CONNECTING, ETC. IN CASE THAT REQUIREMENTS, DEPICTED IN THIS MANUAL ARE NOT SATISFIED, FAILURES OF THE UNIT COULD BE EXPECTED, OR EVEN FATAL CONSEQUENCES, FOR WHICH THE PRODUCER COMPANY DOES NOT TAKE RESPONSIBILITY.

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1. Hot water boiler of series "Pelletherm 30v2 BIO" – description, properties and advantages.

"Pelletherm 30v2 BIO" is steel plate hot water boiler, which uses solid fuel in shape of wood chips as **primary fuel** and wood pellets as **secondary (replacement) fuel** The boiler is designed to be connected to local hot-water heating systems, as well as heating up domestic hot water. The boiler uses **dry calibrated wood chips** or **wood pellets** and other solid biomass as replacement fuel. The generated heat energy is transferred to the circulating hot water and is transferred to the local heating system.

The unit utilizes the following types of fuel:

- **Primary fuel :**
  - ***dry calibrated wood chips*** which have the following parameters of the main fraction P=20 and its moisture content is $W^r \leq 10.0\%$ and its ash content is $A^d \leq 2.0\%$. The fuel should cover the requirements of standard OENORM M7133 : G30, W10, class A1 or A2 for the ash content. According to the European standard for solid biomass fuels: EN 14961-1:2010, Annex 2, P16, M10, A0.7 or A1.5, BD200;
- **Secondary fuel :**
  - ***wood pellets*** with characteristic size (diameter) 6, 8 upto 14 mm, class ENplus-A1, ENplus-A2 and ENplus-B according to standard ENplus, or having the category: A, AB, B, BC, C, CD, E, EF according to methodology, developed and applied by the unit producer company;
  - ***dried nuts*** (from cherries, etc.);
  - **mixture** of dry calibrated wood chips, wood pellets and other (for example in ratio 50% - 50%);
  - ***other biomass in pellet shape***, but its utilization should be confirmed by the unit producer testing laboratory;

The hot water boiler of series "Pelletherm 30v2 BIO" includes:

- *hot water boiler – 1sp.;*
- *ash tray – 1 sp.;*
- *foot-screws for installation and leveling – 8 sp.;*
- *pair of working gloves – 1sp.;*
- *working apron – 1 sp.;*
- *instruction manual – 1 sp.;*
- *annex of the instruction manual – 1 sp;*

The unit is equipped with:

- Steel plates welded heat exchanger for heating-up the circuit water;
- Flue gas fan;
- Fresh air supplying fan;
- Burner's ash removal mechanism – removes the ash residuum out of the burner's grate;
- Daily fuel hopper with capacity of 150dm^3 , which allows storage of about 30kg **dry calibrated wood chips** (**the primary fuel**) or about a 100 kg of **wood pellets** (**as replacement fuel**). However, the described data are tentative, because the real fuel hopper capacity depends on the fuel bulk density, which depend on the fuel particle overall dimensions (both the wood chips and the wood pellets) as well as the moisture content;
- Programmable operating module, which controls the functions of the unit and is adjustable to the specific need of a heating system as well as the properties of the fuel;
- Ash residue container with capacity of approximately 5 kg;
- Manually driven semi-automatic ash cleaning system (this system cleans the ash, deposited on the internal surface of the pipes of boiler's convective section)

The unit is supplied with :

- Automatic fuel ignition system;
- Automatic burner's ash removal system;
- Semi-automatic ash (deposited on the surfaces of the heat exchanger pipes) cleaning system;
- Automatic fuel feeding auger system;

Unit's advantages :

- The hot water boiler is designed to utilize solid biomass fuel, making it environmentally friendly, CO_2 neutral and does not contribute to the global warming process – result of fossil fuel utilization;
- The specific price of the heat energy, delivered by solid biomass utilization is less dependent on the world fuel market trends and practically the heat energy price is competitive to the conventional energy sources;

- The boiler is automatic and the thermal comfort achieved is close to that, originating from exploitation of fully automatic boilers, (for example liquid or gas fuel, as well as electric boiler), which makes is applicable in heating systems, equipped with programmable room thermostat;
- The unit is equipped with automatic fuel ignition system and another one for burner's grate ash cleaning;
- The design of the heat exchanger is optimized and realizes three way flue gas duct, thus allowing intensive heat exchange rate and high efficiency of the boiler (above 90%) and reduced fly ash emissions to the chimney;
- Automatic unit operation. Hot water boiler could be connected to programmable room thermostat (weekly programmable), which guarantees maximal thermal comfort and economical fuel consumption;
- The unit utilizes variety of solid biomass fuel: **dry calibrated wood chips** as primary fuel or as replacement fuel– **wood pellets, dried cherry nuts, etc.,** which have ash content, above the requirements of the standards ENplus (EN 14961-2:2010), ONORM M7135, DIN 51731 и DINPlus;
- High efficiency;
- Low pollutant contents in the flue gases;
- The unit is applicable for domestic hot water heating purposes (DHW);
- Automatic fuel feeding system, transported from the built-in "daily" hopper;
- The control operating module can operate the function of additional external fuel feeding system, which delivers fuel to the built-in fuel hopper from external one. The external fuel hopper could be filled with the **primary fuel** – the **dried calibrated wood chips**, or it can be another container for the **replacement fuel** – for example filled with **wood pellets**;
- Simplified maintenance and service procedures;
- Minimized running costs;
- The boiler's design allows easy detachment and attachment of its main modules, considering the logistic issues, as well as final positioning of the unit in the boiler's room;

2. Hot water boiler of series "Pelletherm 30v2 BIO" technical data.

- Thermal and technical data of the automatic hot water boiler of series "Pelletherm 30v2 BIO" at operation with **main fuel** – ***dry calibrated wood chips*** are given in **Table 2.1**;
- Thermal and technical data of the automatic hot water boiler of series "Pelletherm 30v2 BIO" at operation with **secondary fuel** –***wood pellets*** are given in **Table 2.2**;
- Dimensions and technical data for automatic hot water boiler of series "Pelletherm 30v2 BIO" are given in **Table 2.3;**
- Recommended **primary fuel** properties – ***dry calibrated wood chips*** , are given in **Table 2.4;**
- Net calorific value of **wood chips** at different moisture content and different ash content are given in **Table 2.5**;
- Classification of **wood chips** considering its granulometric composition according to standard EN 14961:2010, are given in **Table 2.6;**
- Wood pellets classification, considering their physical properties according to standard EN 14961:2010 are given in **Table 2.7;**
- Recommended **replacement fuel** properties –***wood pellets*** , are given in **Table 2.8;**
- Wood pellets classification, considering their physical properties (based on the fuel proximate analysis) and categorized according to unit producer methodology is given in **Table 2.9**;
- ENplus – the European standard for wood pellets is shown in **Table 2.10**;

Parameter	Dimension	Value
Model of the hot water boiler	---	Pelletherm 30v2 BIO
Nominal thermal capacity	*kW*	*30*
Thermal capacity operation range	*kW*	*9 – 30*
Main fuel	*Dry calibrated wood chips, having the following characteristics :* ***dimension*** *P=20 mm;* ***moisture*** $W^r \leq 7.0\%$ *;* ***ash content*** $A^d \leq 2.0\%$*;*	
Characteristics of the woof chips, according to EN 14962-1	*P16A, M10, A3, BD200*	
Characteristics of the wood chips according to OENORM M7133	*G30 , M10 , A2*	
Dry calibrated wood chips consumption rate G30, W10, A2 at nominal thermal capacity	*kg/h*	*7.4*
Fresh air flow rate, required for effective combustion process and boiler operation	*kg/h*	*53 - 64*
	m^3/h	*44 - 53*
Mass flow rate of the exhaust gases	*g/s*	*19.8*
Averaged dry wood chips consumption rate in a heating system	*kg/h*	*5.2*
Thermal efficiency at nominal capacity	*%*	*92.5*
Air excess ratio	λ	*1.6 – 1.7*
Flue gases temperature at nominal thermal capacity	*°C*	*160 – 170*
Solid fuel residue	*ash*	*The quantity depends on the ash contents in the raw fuel, as well as operating conditions*

Table 2.1 Thermal and technical data for automatic hot water boiler of series “Pelletherm 30v2 BIO” at operation, utilizing **main fuel – *dry calibrated wood chips*.**

Parameter	Dimension	Value
Model of the hot water boiler	---	Pelletherm 30v2 BIO
Nominal thermal capacity	*kW*	*30*
Thermal capacity operation range	*kW*	*9 – 30*
Secondary fuel	• *Wood pellets;* • *Dry cherry nuts;* • *Other dried nuts;*	
Utilized wood pellets, complying ENplus	*ENplus-A1, Enplus-A2, ENplus-B*	
Utilized pellets, complying with boiler's producer classification methodology	*A, AB, B, BC, C, CD, D, DE*	
Wood pellets consumption rate at nominal thermal capacity	*kg/h*	*6.9*
Fresh air flow rate, required for effective combustion process and boiler operation	*kg/h*	*50 - 60*
	m^3/h	*42 - 50*
Mass flow rate of the exhaust gases	*g/s*	*18.6*
Averaged wood pellets consumption rate (the unit is operating in a popular heating system)	*kg/h*	*4.5*
Thermal efficiency at nominal capacity	*%*	*92.5*
Air excess ratio	*λ*	*1.6 – 1.7*
Flue gases temperature at nominal thermal capacity	*°C*	*160 – 170*
Solid fuel residue	*ash*	*The quantity depends on the ash contents in the raw fuel, as well as operating conditions*

Table 2.2 Thermal and technical data for automatic hot water boiler of series "Pelletherm 30v2 BIO" at operation, utilizing **secondary fuel – *wood pellets*.**

Parameter		Dimension	Value
Model of the hot water boiler		---	Pelletherm 30v2 BIO
Weight		*kg*	*465*
Water jacket capacity		*dm³*	*95*
Fuel hopper capacity		*dm³*	*152*
		kg	*30 kg dry calibrated wood chips*
			100 kg wood pellets
Overall dimension of the unit (WxDxH)		*mm*	*1515 x 850 x 1375*
Class (according to EN 303-5)		-	*3*
Operating overpressure of the circulating water		*MPa*	*0.25*
Heating system expansion vessel type		-	*Opened or closed (up to 0.25MPa)*
Factory tested overpressure		*MPa*	*0.4*
Recommended circulating water temperature		*°C*	*80*
Minimal recommended return water temperature		*°C*	*60*
Draught		*hPa*	*0.1 - 0.2*
Connections	*Supply/return flow*	*G*	*1½"*
	Drainage	*G*	*½"*
	Flue gases duct	*mm*	*150*
Hydraulic losses of the circulating water at nominal thermal capacity		*hPa*	*2.95*
Power supply		-	*L1, N, PE, 50Hz; 230V*
Electrical capacity		*VA*	*120 + 250 (at ignition process)*
Electric protection		-	*IP20*

Table 2.3. Dimensions and technical data for automatic hot water boiler of series "Pelletherm 30v2 BIO".

Parameters of the recommended **main fuel**– ***dry calibrated wood chips***, for the hot water boilers of series "Pelletherm 30v2 BIO" are given in the following table**.**

Parameter	Symbol	Dimension	Value
Wood chips particles main fraction size	**P**	*mm*	*20*
Moisture content	**M (W^r)**	*%*	*≤ 10*
Ash content	**A**	*%*	*≤ 1.5*
Bulk density	**BD**	*kg/m^3*	*200*
*Recommended main fuel low calorific value - **LHV***	**LHV**	*MJ/kg*	*>16.0*
		kWh/kg	*>4.4*
Wood chips properties according to EN 14962-1	---	*P16A, M10, A3, BD200*	
Wood chips properties according to OENORM M7133	---	*G30 , M10 , A2*	

Table 2.4. Recommended **primary fuel** properties – ***dry calibrated wood chips***

The wood chips quality clacification is based on the fuel properties estimation, as described in the table above. In practice the fuel net calorific value depends on the fuel moisture content and is only slightly dependent on the fuel ash content. The following table contain parametric data for the wood chips net calorific value as function of the moisture content and a second parameters – its ash content.

Symbols :
A^d – ash content, dry base , [%];
W^r – moisture content of the raw fuel, [%];
LHV– fuel low heating value, [MJ/kg, kWh/kg];

W^r = 10%		
A^d	**LHV**	
%	MJ/kg	kWh/kg
1.0	16.17	4.49
2.0	15.98	4.44
3.0	15.80	4.39
4.0	15.60	4.34
5.0	15.42	4.28
6.0	15.23	4.24
7.0	15.04	4.18
8.0	14.87	4.13

W^r = 20%		
A^d	**LHV**	
%	MJ/kg	kWh/kg
1.0	14.10	3.91
2.0	13.94	3.87
3.0	13.78	3.83
4.0	13.60	3.78
5.0	13.44	3.74
6.0	13.28	3.69
7.0	13.10	3.64
8.0	12.95	3.60

W^r = 30%		
Ad	**LHV**	
%	MJ/kg	kWh/kg
1.0	12.05	3.34
2.0	11.90	3.30
3.0	11.75	3.26
4.0	11.60	3.23
5.0	11.46	3.18
6.0	11.32	3.15
7.0	11.18	3.10
8.0	11.03	3.07

Table 2.5. Net calorific value of **wood chips** at different moisture content and different ash content.

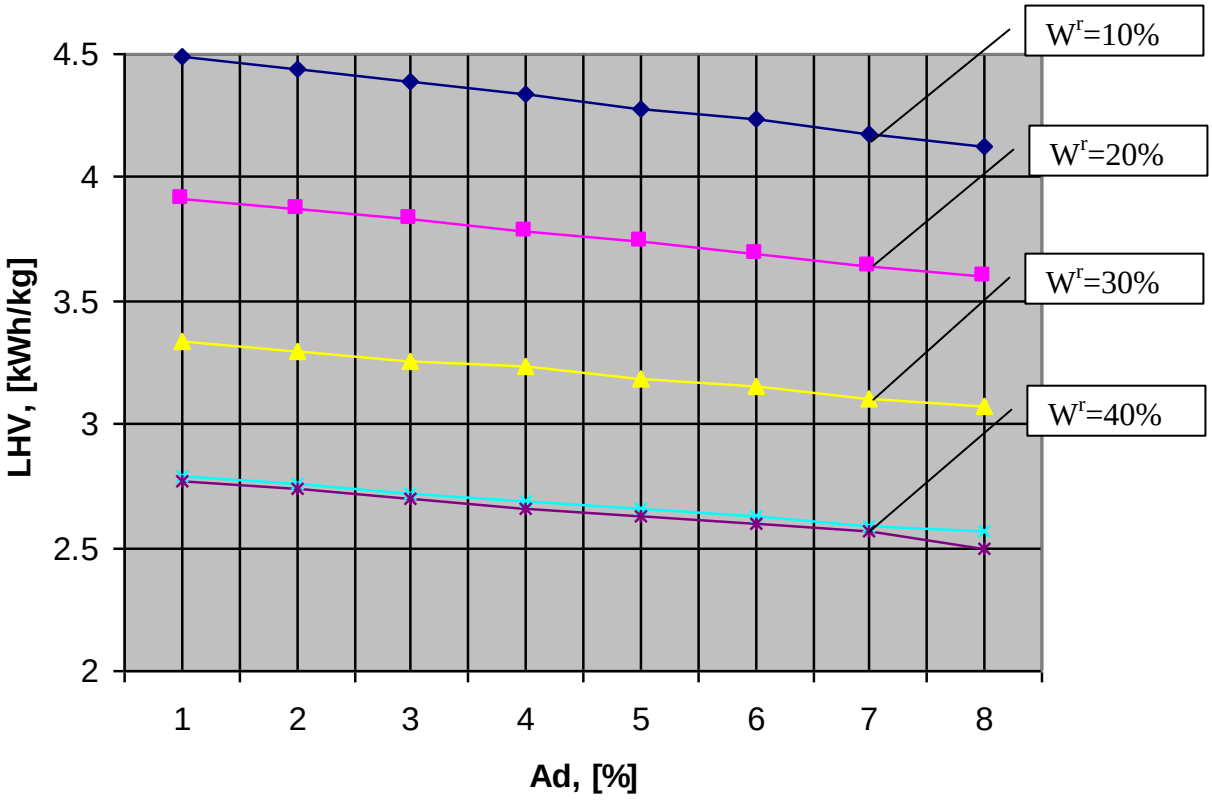


Figure 2.1. Wood chips net calorific value, as function of the moisture and ash content;

The following tables contain wood chips classification, based on their characteristics, according to the standard EN 14961:2010.

Symbol	Main fraction	Fine fraction (<3.15mm)	Coarse fraction (%), maximal wood particles length [mm]
Dimensions			
P16A	3.15 ≤ P ≤ 16 mm	≤ 12%	≤ 3% , >16 and all < 31.5mm
P16B	3.15 ≤ P ≤ 16 mm	≤ 12%	≤ 3% , >45 and all < 120 mm
P45A	8 ≤ P ≤ 45 mm	≤ 8 %	≤ 6% , >63mm and max 3.5%>100mm, all <120mm
P45B	8 ≤ P ≤ 45 mm	≤ 8 %	≤ 6% , >63mm and max 3.5%>100mm, all <350mm
P63	8 ≤ P ≤ 63 mm	≤ 6%	≤ 6% , >100 mm, all <350mm
P100	16 ≤ P ≤ 100 mm	≤ 4%	≤ 6% , >200 mm, all <350mm

Table 2.6. Wood chips classification according to their granulometric content, according to standard EN 14961:2010;

Parameter	Symbol	Value
Moisture content	M10	≤ 10 %
	M15	≤ 15 %
	M20	≤ 20 %
	M25	≤ 25 %
	M30	≤ 30 %
	M35	≤ 35 %
	M40	≤ 40 %
	M45	≤ 45 %
	M50	≤ 50 %
	M55	≤ 55 %
	M55+	> 55 % (max. value must be specified)
Ash content	A0.5	≤ 0.5 %
	A0.7	≤ 0.7 %
	A1.0	≤ 1.0 %
	A1.5	≤ 1.5 %
	A2.0	≤ 2.0 %
	A3.0	≤ 3.0 %
	A5.0	≤ 5.0 %
	A7.0	≤ 7.0 %
	A10.0	≤ 10.0 %
	A10.0+	> 10.0 % (max. value must be specified)

Table 2.7. Wood chips classification according to their proximate analysis, according to standard EN 14961:2010;

Parameters of the recommended **secondary fuel** – ***wood pellets***, for the hot water boiler of series "Pelletherm 30v2 BIO" are given in the following table**.**

Parameter	Dimension	Value
Pellets diameter	*mm*	*6 – 14*
Recommended net calorific value	*MJ/kg*	*>17.2*
	kWh/kg	*>4.7*
Wood pellets class according to ENplus	---	**ENplus-A1 , ENplus-A2 Enplus-B**
Pellet category (according to unit producer methodology)	---	A, AB, B, BC, C, CD, E, EF
Ash content	*%*	*See Tables 2.9. and 2.10.*
Moisture	*%*	*Max. 8 – 10%*

Table 2.8 Parameters of the recommended **secondary fuel** – ***wood pellets*****.**

Wood pellets classification, according to their proximate analysis properties are given in the following table.

Pellets category	A^d	DU
A	$A^d \leq 0.6\%$	$DU \geq 97.0\%$
AB	$A^d \leq 0.6\%$	$DU < 97.0\%$
B	$0.6 < A^d \leq 1.0\%$	$DU \geq 97.0\%$
BC	$0.6 < A^d \leq 1.0\%$	$DU < 97.0\%$
C	$1.0\% < A^d \leq 2.0\%$	$DU \geq 97.0\%$
CD	$1.0\% < A^d \leq 2.0\%$	$DU < 97.0\%$
D	$2.0\% < A^d \leq 3.0\%$	$DU \geq 97.0\%$
DE	$2.0\% < A^d \leq 3.0\%$	$DU < 97.0\%$
E	$A^d > 3.0\%$	$DU \geq 97.0\%$
EF	$A^d > 3.0\%$	$DU < 97.0\%$

Table 2.9 Pellets classification, considering their physical properties (based on fuel proximate analysis) – according to fuel evaluation methods, developed and applied in boiler's producer company;

where:

A^d – *ash contents, dry basis*, [%];
DU – *mechanical durability*, [%];

The European wood pellets standard EN 14961-2:2010 defines wood pellets certificate ENplus for pellets, utilized in boilers and appliances for domestic heating systems. The certificate EN-B is applied for pellets, utilized in industrial boilers. In principal the ENplus standard defines two quality classes: A1 и A2. The class A1 is highly restricted, considering the ash content. The class A2 the limit of the ash content of the wood pellets is higher – up to 1.5%. For industrial boilers the certificate EN-B is applicable, which defines fewer restrictions on the pellets quality.

Parameter	**Dimension**	**ENplus-A1**	**ENplus-A2**
Diameter	mm	6 (± 1)	6 (± 1)
Length	mm	3,15 ≤ L ≤ 40 [1)]	3,15 ≤ L ≤ 40 [1)]
Bulk density	kg/m³	≥ 600	≥ 600
Low calorific value	MJ/kg	≥ 16.5	≥ 16.5
Moisture content	%	≤ 10	≤ 10
Dust	%	≤ 1 [3)]	≤ 1 [3)]
Mechanical durability	%	≥ 97.5 [4)]	≥ 97.5 [4)]
Ash content	% [2)]	≤ 0,7	≤ 1.5
Ash melting point temperature	°C	≥ 1200	≥ 1100
Cl	% [2)]	≤ 0.02	≤ 0.03
S	% [2)]	≤ 0.05	≤ 0.05
N	% [2)]	≤ 0.3	≤ 0.5
Cu	mg/kg [2)]	≤ 10	≤ 10
Cr	mg/kg [2)]	≤ 10	≤ 10
As	mg/kg [2)]	≤ 1	≤ 1
Cd	mg/kg [2)]	≤ 0.5	≤ 0.5
Hg	mg/kg [2)]	≤ 0.1	≤ 0.1
Pb	mg/kg [2)]	≤ 10	≤ 10
Ni	mg/kg [2)]	≤ 10	≤ 10
Zn	mg/kg [2)]	≤ 100	≤ 100

1) not more that 1% of the wood pellets should be with length of 40 mm, the maximal pellet length is 45 mm ;
2) determined on dry mass;
3) the particles are <3.15 mm, fine particles, before fuel delivery;
4) in case the test measurements are performed with Lignotester, than the limit value is ≥ 97.7% m.w.;

Table 2.10 ENplus - European standard for wood pellets;

3. Description of the automatic hot water boiler of series "Pelletherm 30v2 BIO".

The heat exchanger of the boiler complies with the acting requirements for such kind of units, defined in operating norm : *EN 303-5/2000 – „Heating boilers for solid fuels, hand and automatically fired, nominal heat output up to 300 kW. Terminology, requirements, testing and marking".*

The unit consists of:

- Main part of the unit is **heat exchanger**. In the combustion chamber of this exchanger is mounted specialized grate burner, designed for horizontal fuel feeding;
- **The heat exchanger** is welded construction of carbon steel plates and steel pipes. The lower part of the exchanger is designed as combustion chamber. The burner is mounted in this chamber and conditions efficient combustion process;
- **Specialized stainless steel burner,** horizontally mounted in the combustion chamber of the heat exchanger
- **Ash container,** positioned in the lower part of the combustion chamber, below the burner;
- **Fuel hopper** is mounted aside of the boiler's heat exchanger. Beneath the hopper is mounted a fuel-auger separator (which also acts as fuel proportioner), followed by horizontal transport auger. The fuel proportioner prevent the so called "back fire" process, i.e. ignition of the fuel in the hopper by the hot flue gases in the auger duct in case of abnormal situations;
- **Fresh air fan** is mounted on the air duct of the burner. The fan is equipped with position adjustable air flow rate control flap. Additionally the air duct is equipped with two separate flaps for individual adjustment of the primary and secondary air flow rate. These flaps are factory set and in principal need no adjustment;
- **Inflow and outflow connections (to/from the heating system)** of the supply and return circulating water are internal threads of size G1½", positioned in the rear side of the heat exchanger;
- **Draining connection** is internal thread, diameter G½" and is positioned on the lower part of rear side of the heat exchanger. An appropriate drainage valve should be attached;

- **Flue gases exit duct (**its external diameter is 150mm**)** is positioned in the upper rear side of the heat exchanger (after the flue gases fan, concerning the flue gases track), utilized for forced flue gases extraction;
- **Boiler's heat exchanger** is covered with decorative covers, isolated with mineral wool plates, ensuring low heat losses to the ambient environment;
- **Outer decorative covers** are carbon steel plates color painted details;

Figure 3.1 Side view of the automatic hot water boiler of series "Pelletherm 30v2 BIO";

The unit is designed and assembled in two main modules – the heat exchanger (the left one) and the fuel hopper module (the right one, consisting of fuel hopper, specialized burner, fuel transport auger and control module). These modules are easily detachable and could be assembled onsite if necessary;

The producer reserves the right to make changes of the design of the hot water boiler of series "Pelletherm 30v2 BIO" without obligations to inform the clients for that process.

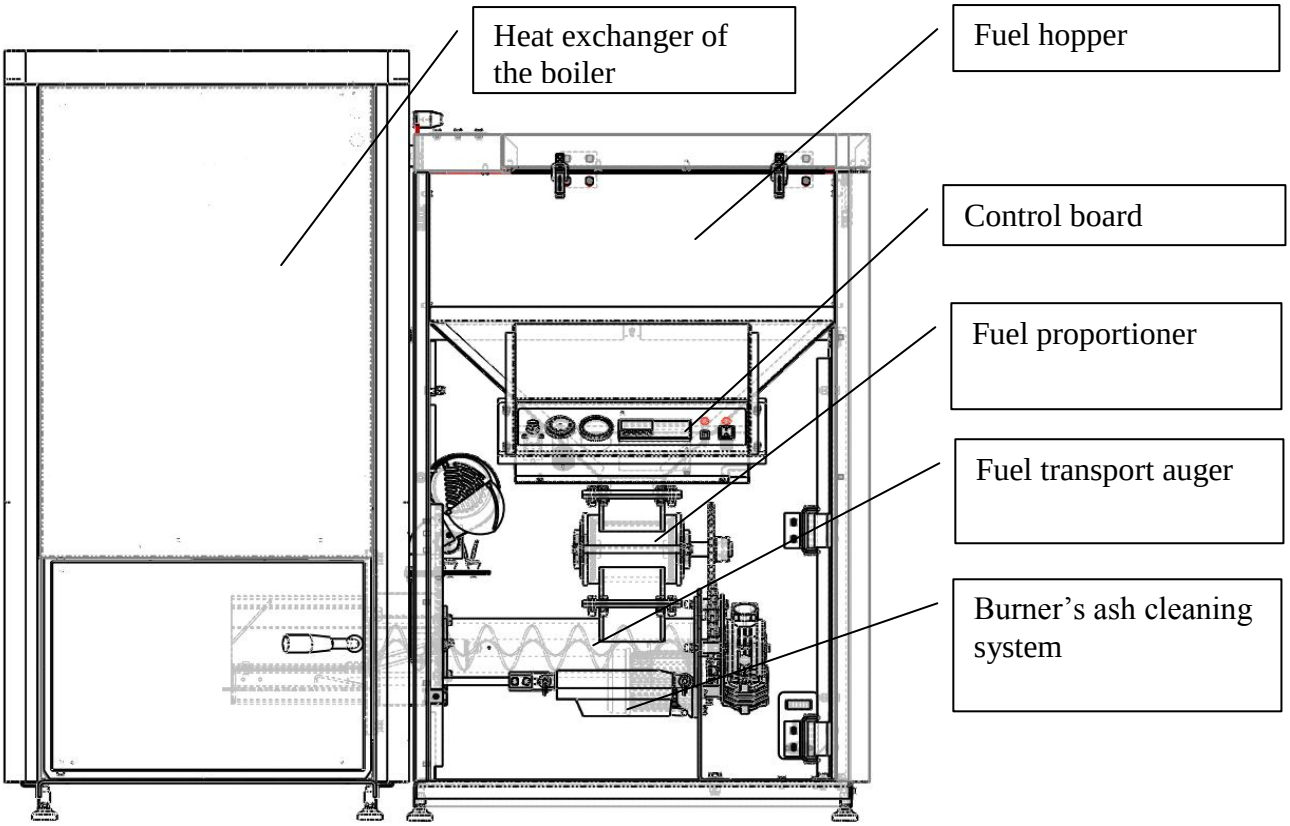


Figure 3.2 Partly sectioned view of automatic hot water boiler of series "Pelletherm 30v2 BIO" – *front view*;

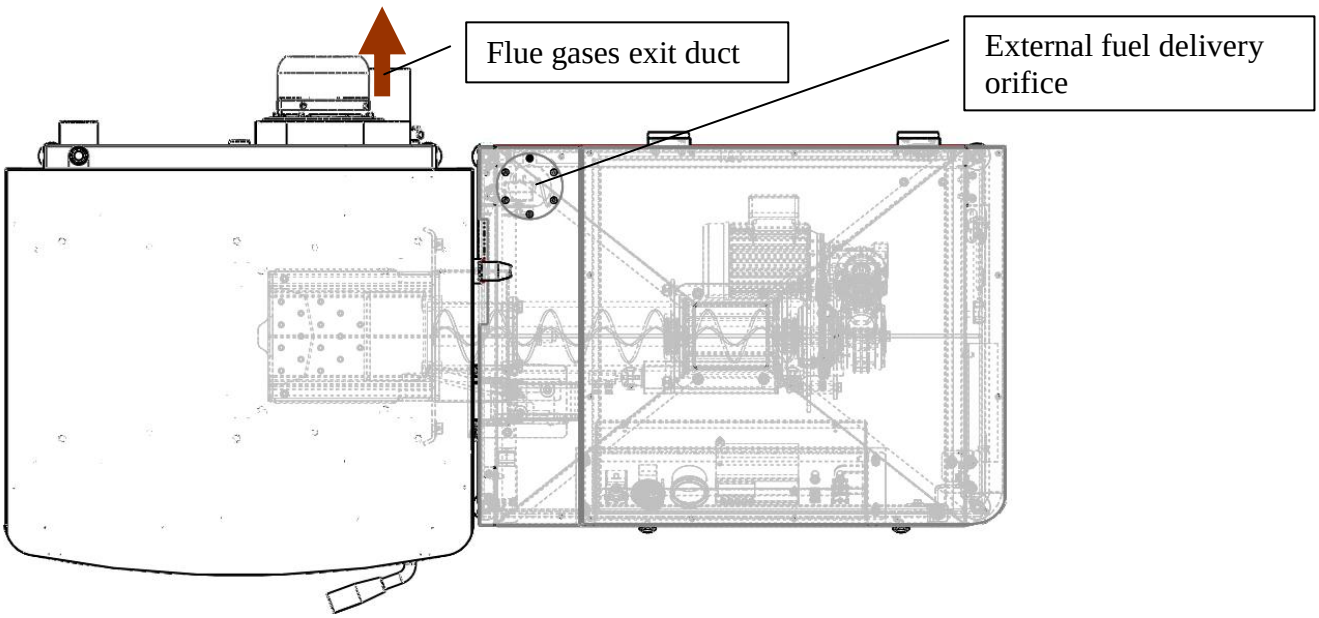


Figure 3.3 External view of automatic hot water boiler of series "Pelletherm 30v2 BIO" – *top view*;

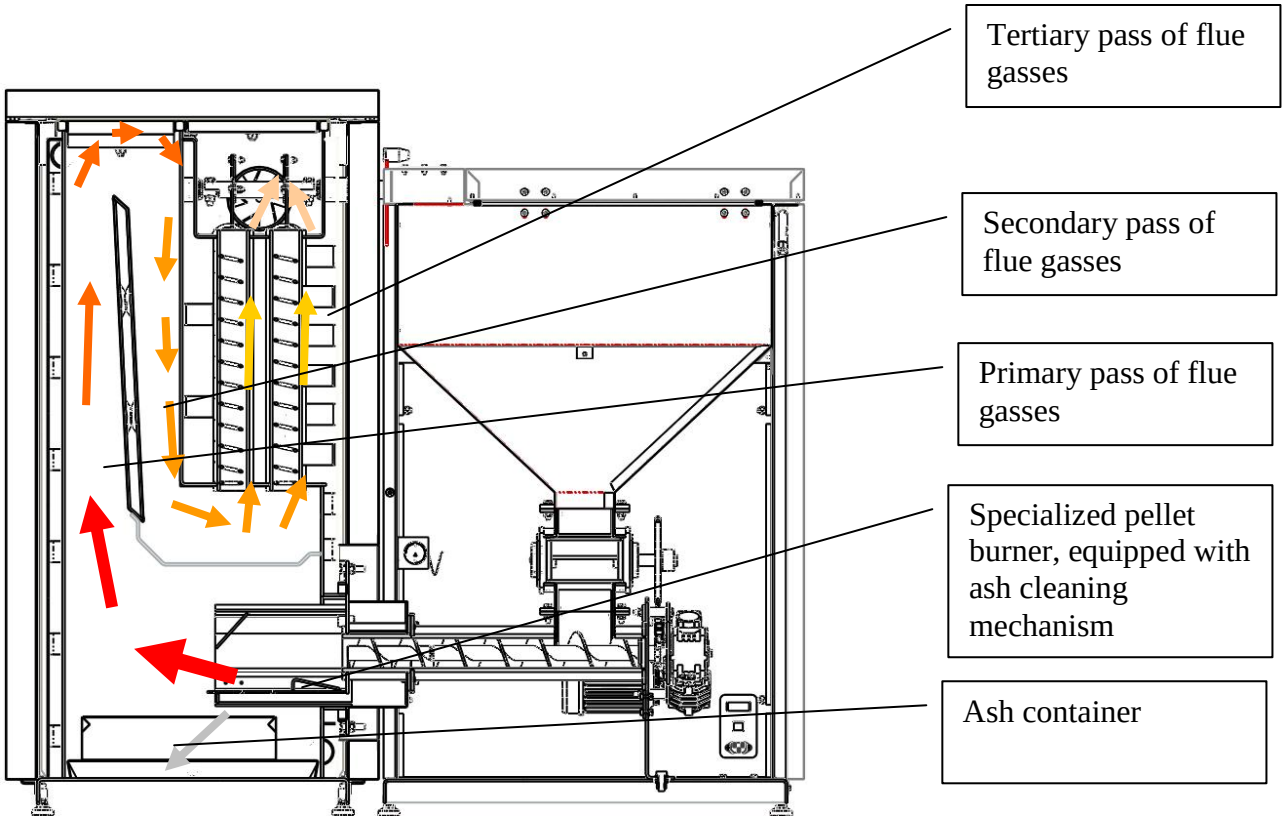

Tertiary pass of flue gasses
Secondary pass of flue gasses
Primary pass of flue gasses
Specialized pellet burner, equipped with ash cleaning mechanism
Ash container

Figure 3.4 Cross section view of automatic hot water boiler of series "Pelletherm 30 v2 BIO". The flue gasses duct and streamlines are visualized as well;

4. Installation process.

Norms and recommendations.

Basic requirements for installation of automatic hot water boiler of series "Pelletherm 30v2 BIO":

- The room, dedicated to mount the boiler, should be supplied with fresh air supply duct, necessary for optimal combustion process as well as room ventilation;
- Installation of the unit in inhabitable premises, including dwelling corridors, is not allowed;
- The hot water boiler should be connected to the heating system by authorized personal only;
- Installation and service procedures of solid fuel hot water boilers should be performed by authorized qualified and certified personal ONLY;
- The automatic hot water boiler of series "Pelletherm 30v2 BIO" should be connected to heating system, supplied with **OPENED** or **CLOSED** expansion vessel. In case the heating system is equipped with **closed** expansion vessel, then the system should be equipped with over-pressure safety valve, which opens at pressure exceeding the operating one of the hot water boiler (0.25 MPa) and this overpressure safety valve should be certified according to PED 97/23
- Both the entire heating system and the boiler should be totally filled with circulating fluid (water) and air-free before operating the boiler;
- Maintenance procedures of the boiler should be performed by trained adult persons, which have read the user manual of the unit;

Installation procedure of the boiler requires engineering project for the heating system, prepared according to the acting local norms and recommendations as follows:

- To the heating system - EN 303-5/2000 - „*Heating boilers. Part 5 : Heating boilers for solid fuels, hand and automatically fired, nominal heat output of up to 300 kW. Terminology, requirements, testing and marking*";
- To the chimney;
- Fire prevention requirements;
- To the power circuit - EN 60335-1/1997- "*Household and similar electrical appliances – safety, Part 1 – General requirements*";

- Appliance positioning in order to achieve comfortable maintenance.
  - Minimal distance of 1000mm in front of the unit and any wall should be provided;
  - Minimal distance of 400mm from the rear wall of the unit and any wall should be provided;
  - Minimal distance of 500mm from the right hand side of the unit and any wall should be provided, in order to guarantee easy access to the fuel transporting auger, as well as the other modules, installed in this section of the boiler;
  - Minimal distance of 300mm from the left hand side of the unit and any wall should be provided, in order to guarantee easy access at servicing of the flue gas fan of the unit;
  - Minimal distance of 600mm above of the unit and any ceiling(wall) should be provided, in order to guarantee easy access to the fuel's hopper, as well as enough room for cleaning purposes of the heat exchanger body as well as fuel hopper charging;

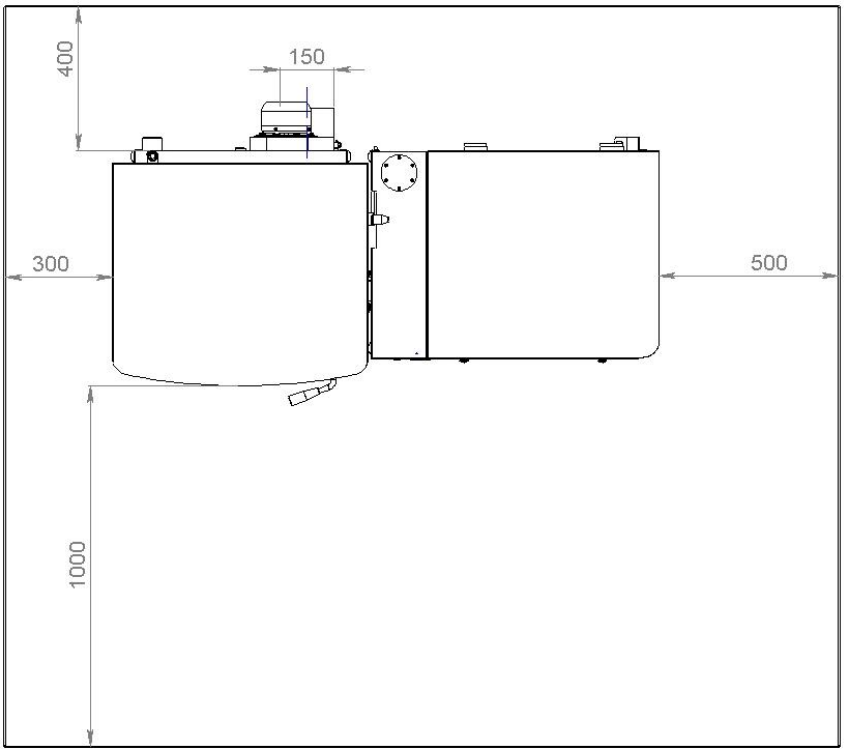


Figure 4.1 Positioning of automatic hot water boiler of series " Pelletherm 30v2 BIO" – the minimal distances between the unit and any walls/obstacles of the boiler's room are shown;

- Positioning the main fuel hopper – **dry calibrated wood chips** – this hopper should be installed (or build onsite) and should allow easy access as well as easy fuel charging. The fuel hopper design should consider the requirements for the installation of the external fuel transport auger, the inclination angle of the lower hopper surfaces in order to allow free fuel flow to the extraction

section, a revision orifice for easy cleaning the fine fraction residues, etc. The design and installation of the fuel hopper should be performed by specialized trained company, which have experience with the installation of such type of systems;

- The hot water boiler should be positioned in the boiler's room according to the requirements for attaching electrical appliances to the power circuit – the unit should be positioned in a way, that will provide easy access to the power supply plug (230V/50Hz);

ATTENTION: *the installation process of the boiler is finalized by performing so called "hot tests" procedure of the heating installation and the warranty card is filled with the required information.*

The recommended principal hydraulic scheme for connecting the automatic hot water boiler of series "Pelletherm 30v2 BIO" to the heating system is snow on the following figure.

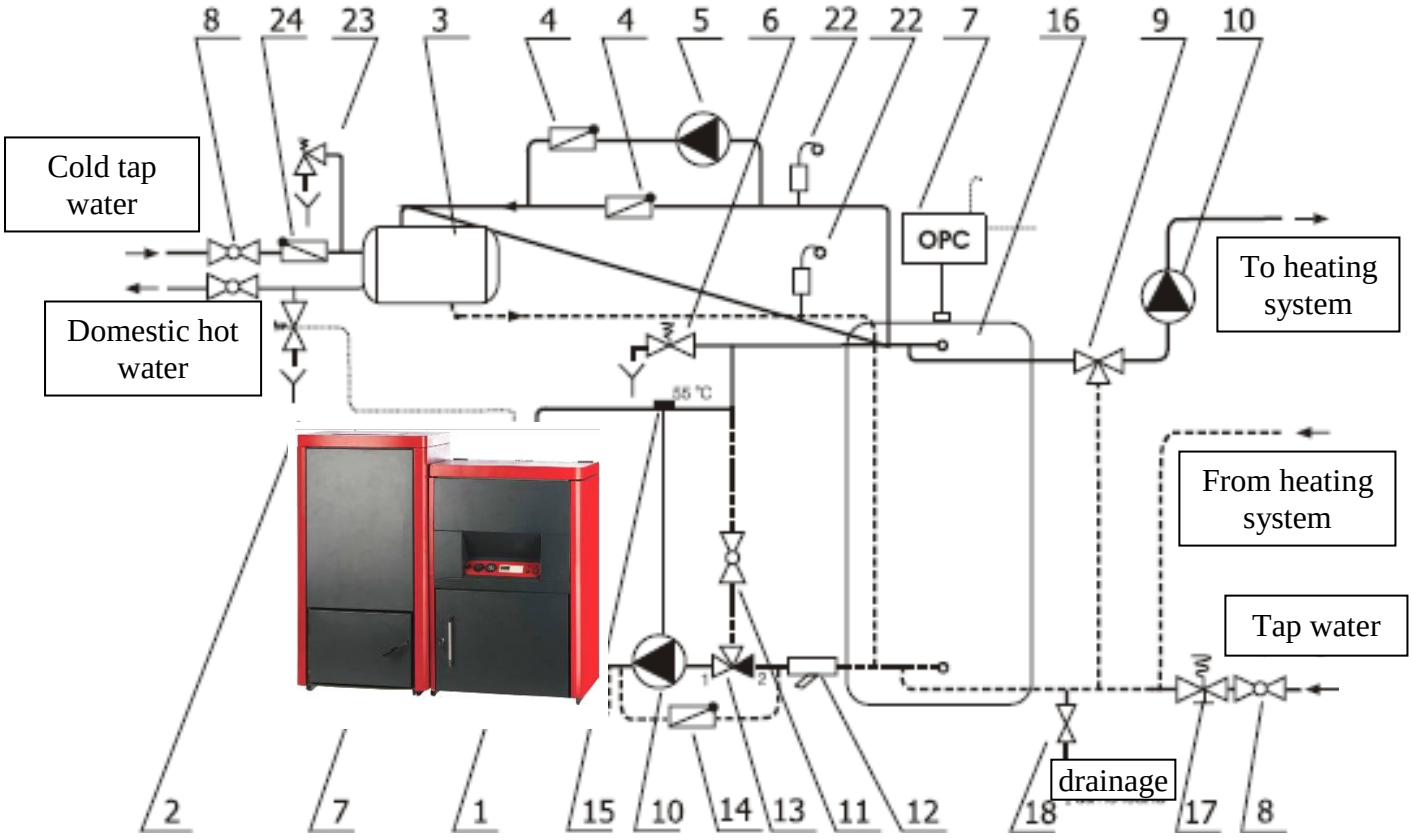


Figure 4.2. Recommender principal hydraulic scheme for connecting the automatic hot water boiler of series "Pelletherm 30v2 BIO" to the heating system, equipped with mixing valve and heat accumulator

NOTE : *According to standard EN 303-5 the heat accumulator is obligatory module of a heating system, equipped with solid fuel hot water boiler. The dimensioning of the heat accumulator tank is described in the above mentioned standard. The boiler producer could assist in appropriate designing of that module as well.*

Index	Designation
1	Hot water boiler of series "Pelletherm 30v2 BIO"
2	Safety valve
3	Hot water boiler
4	Return valve
5	Circulating pump 1
6	Control valve
7	Expansion vessel
8	Control valve
9	Three way mixing valve
10	Circulating pump 2
11	Control valve

Index	Designation
12	Water filter
13	Thermovalve TV
14	Return valve
15	Contact thermostat
16	Heat accumulator
17	Automatic circulating water charger
18	Drainage valve
22	Automatic air separator
23	Safety valve
24	Return valve

Table 4.1. Designation of the elements, indexed on figure 4.2

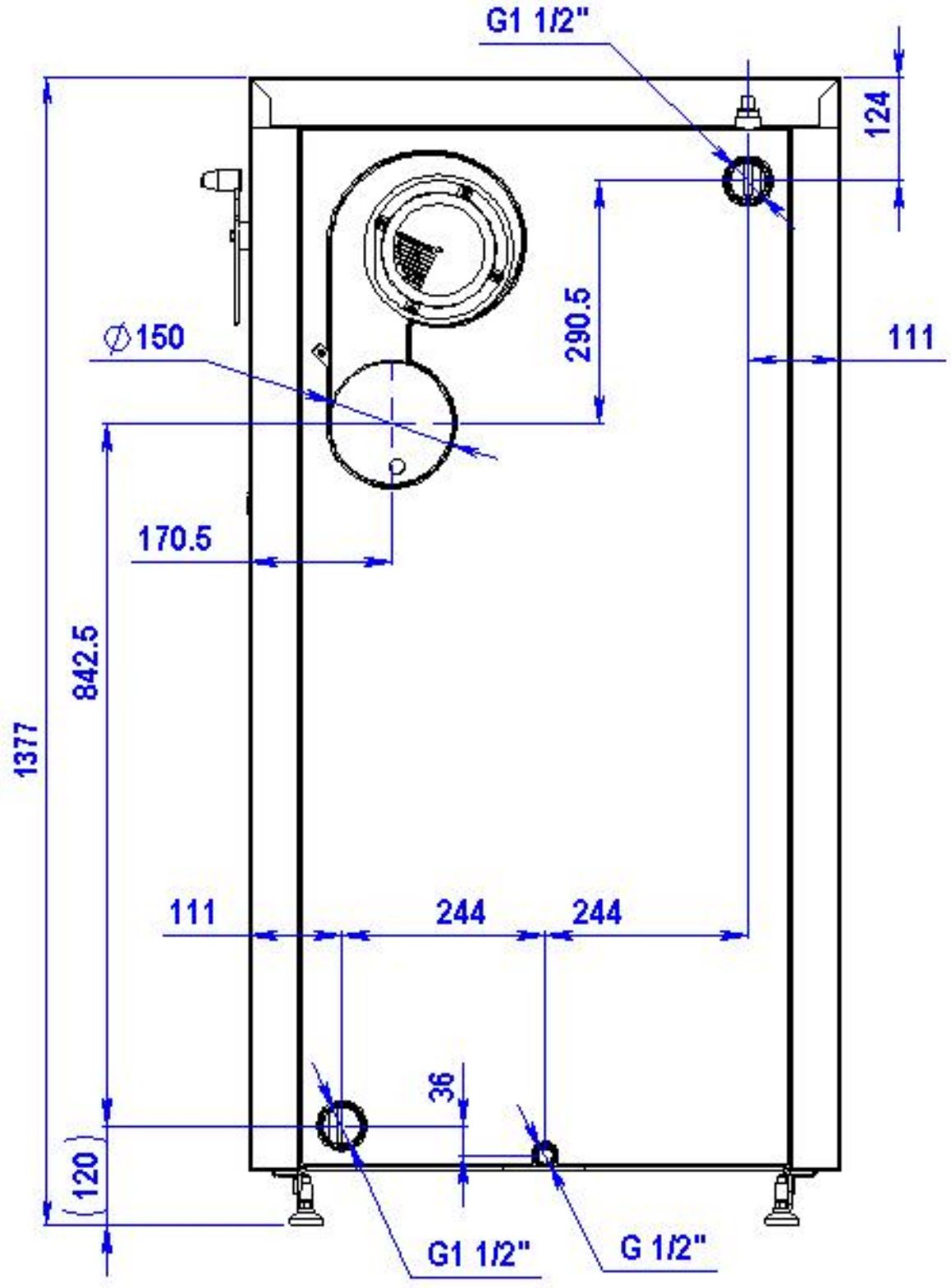
4.1. Automatic hot water boiler connection methodology

4.1.1. Connecting to the chimney

After the boiler has been positioned and leveled (utilizing the leveling screws, installed in the lower corners of the heat exchanger as well as the fuel hopper module), the unit should be connected to an appropriately sized and designed chimney.

4.1.2. Connecting to the heating system

After the flue gas duct of the boiler is connected to a chimney, the automatic hot water boiler of series "Pelletherm 30v2 BIO" should be connected to the heating system – *utilize appropriately sized fitting, according to the preliminary prepared project.*



Фигура 4.3. Back side view of heat exchanger connections of the automatic hot water boiler “Pelletherm 30v2 BIO”;

5. Hot water boiler installation and starting procedures.

ATTENTION : The unit should be installed, adjusted and verified ONLY by trained and authorized staff.

5.1. Basic fuel requirements.

- In order to achieve complete combustion of the utilized fuel, it is required to use fuel, which complies with fuel requirements, described in the tables, referring the **main fuel** – **dry calibrated wood chips** and the **secondary fuel** as well. The unit producer recommends that the fuel should be stored in dry and well ventilated rooms;
- It is strongly forbidden to store the fuel in close region of the boiler, the minimal safety distance between the fuel and the appliance is 400 mm;
- The unit producer recommends an optimal distance between the boiler and the fuel container to be at least 1000mm. It is recommended to store the fuel in room, next to that, where the boiler is installed;
- At the installation procedure of the unit, as well as the fuel storage one, fire prevention recommendation should be considered. It is also recommended to install a fire-extinguisher in a safe and easy accessible place;

In principle heating systems, which are hydraulically opened to the atmosphere allow direct contact between the circulating fluid (in most cases it is water) and the air. During the heating season the water content in the expansion vessel absorbs oxygen from the atmosphere though the free surface. The increased oxygen content in the water threatens the metal of the unit, as well the pipes. Through the free surface of the expansion vessel water evaporation is observed as well. Considering these, appropriate water should be added through the expansion vessel – it must cover the requirements of norm BDS 15207-81.

During the heating season regular checking of circulating water level in the expansion vessel should be performed by the end user. The water content in the circulating system should be kept constant. If additional water is required, then precautions should be taken, not to add air in the heating system as well. The water, utilized for filling purposes of the heating system should be decontaminated and air-free, and is not dedicated for any other purposes, but as a circulating fluid only. Any heating system drainage is inadmissible, except when repairing modules/sections of the system. Practical experience shows that water level checkup should be performed regularly in a period of 14 days in order to sustain quasi-constant water content.

In case that additional water is required, the filling process should be performed carefully, when the hot water boiler is cooled to the ambient temperature. This precautions are induced due to prevent rising of thermal stress of the steel boiler's body and its damage (leakage).

In case that the boiler as well as the heating installation will not be in exploitation for a long period, then in order to prevent local water freezing and damages, it is advisable to perform total drainage of the circulating water. Please take into account that the presence of liquid in the heating system, as well in the boiler will prevent oxidation process of the metal surfaces, corrosion and system failures.

5.2. Starting the automatic hot water boiler of series "Pelletherm 30v2 BIO" procedure.

Basic requirements:

- Any maintenance procedures should be performed in accordance with the described in this manual;
- Any intervention in the working process of the unit, which could lead to unit's failure and/or dangerous and health threatening situations, are strongly prohibited;
- The unit should be checked by the maintenance staff or any trained personal regularly;
- The end-user should not perform any interventions, repairs, etc. of the unit. In case that warning and failures arise, check the failures table (applied at the end of this manual) and call the service support if the case is not described there;
- Any adjustments of thermal capacity higher than the nominal thermal load of the unit are not allowed;
- The ash, deposited in the combustion chamber of the boiler, should be collected in fireproof containers and cooled down to ambient temperature. The cooled ash should be disposed in appropriate waste containers. Please take into account that the mineral ash, result of wood biomass could be considered as soil fertilizer and dispersed for agricultural purposes for example;
- The door of the fuel hopper section of the boiler is equipped with a safety switch and in case the door is opened, then the motor of the fuel transport auger will be powered off for safety reasons – this door should be kept closed;

5.2.1. Interface control board of automatic hot water boiler of series "Pelletherm 30v2 BIO"

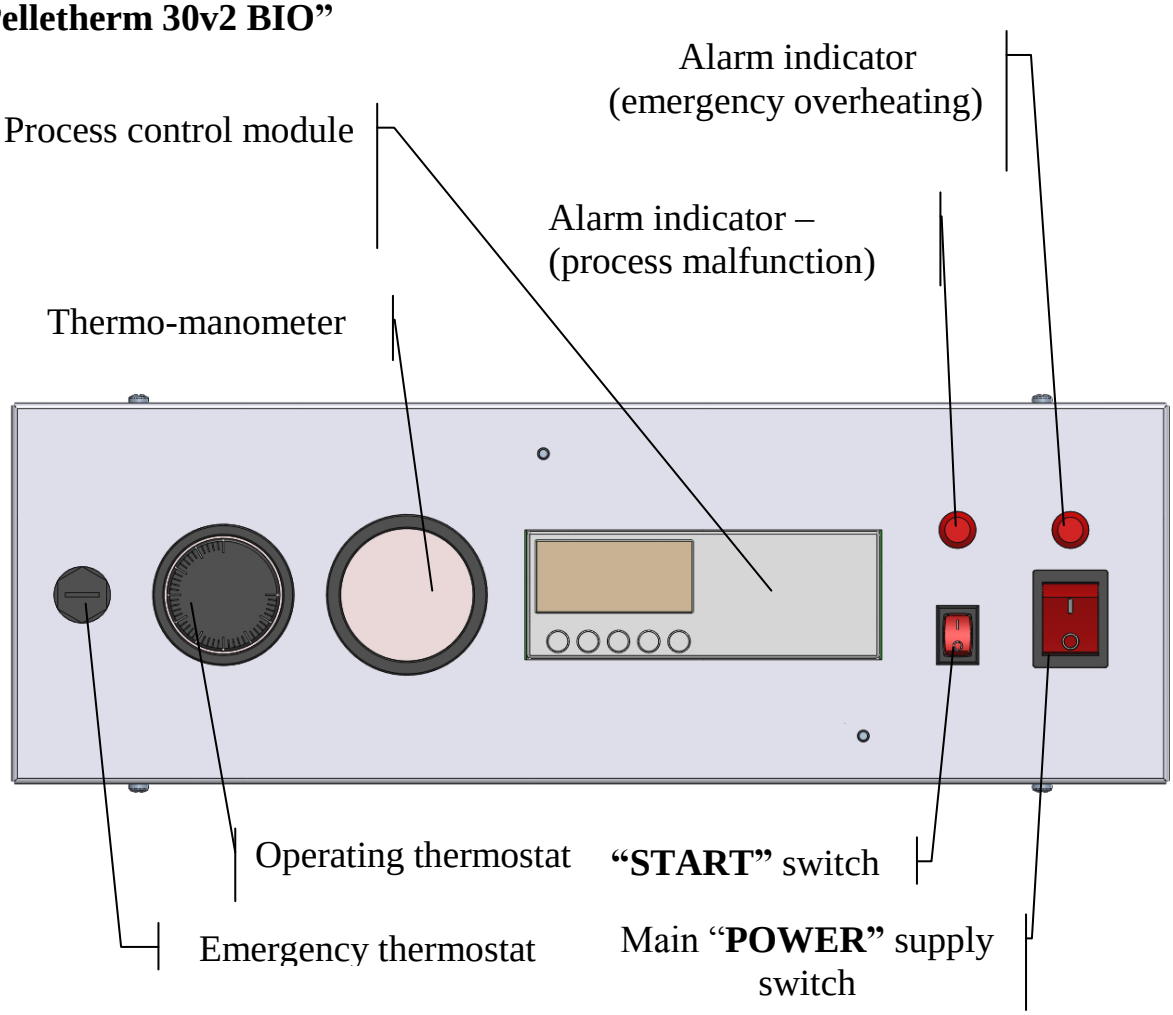


Figure 5.1. Interface control board, equipped with control and operating devices of automatic hot water boiler of series "Pelletherm 30v2 BIO".

Interface control board devices description:

- Main "**POWER**" switch – *switches ON and OFF the main power supply of the boiler*;
- **Operating thermostat** – *assigns the set-point of circulating water in the boiler. The boiler will run until this set-point is reached and will supply heat energy to the heating system*;
- **Emergency thermostat** – *protects the boiler from exceeding emergency temperature level and boiler overheating. This thermostat is factory preset to switch off the unit at water temperature in the boiler above 95^{o}C*;
- **Thermo-manometer** – *indicates the operating temperature of the circulating water in the heat exchanger jacket of the boiler, well as water overpressure*;
- "**START**" switch – *sends "START/STOP" signal to the process control module, which controls the operation of the boiler;*

- **Process control module** – *a programmable unit, that controls the functions of unit according to predefined program (firmware)*;
- **Alarm indicator -process malfunction** – *indicates any abnormal state of the boiler, for details check the information, written on the process control module's display;*
- **Alarm indicator – emergency overheating** – *indicates emergency overheating state of the boiler, due to activation of the emergency thermostat of the boiler. In case of activation, cool down the unit and check and repair the reason for the emergency situation, finally reset the emergency thermostat*;

5.2.2. Hot water boiler power supply.

- The boiler should be connected to the chimney according to the installation's project. This duct should be sealed and verified that there is no flue gases leakage;
- The boiler should be connected to the heating system, the system, as well as the water jacket of the heat exchanger should be filled with circulating liquid, free of air, the control modules (valves, pumps, motor-valves, etc.) should be checked for functionality as well;
- The unit should be connected to the main power supply, according to the safety rules and appropriate norms;
- The main fuel hopper should be filled with dry calibrated wood chips, the boiler's fuel transport auger should be filled with fuel as well, in order to allow uninterruptable and reliable unit operation;
- The boiler's fuel hopper should be filled in order to allow the boiler's fuel transport auger to supply the fuel to the burner's grate. It is recommended to keep the fuel hopper's lid closed in order to minimize the uncontrolled air flow through this module of the unit;

  NOTE : *at the boiler's very first start, as well as in case the fuel in the hopper has been totally consumed, the fuel transport auger is emptied and need to be refilled, which takes time. In order to allow refilling of the fuel transport auger, the boiler's operation should be restarted, until the fuel reaches the entrance section of the burner's grate;*

5.2.3. Hot water boiler very first start.

The unit is switched on by the main "POWER" supply switch, placed on the control board. The unit gets activation signal by switching ON the "START" and goes into automatic operating mode – it goes through ignition mode if needed. If the "START" switch is OFF then the boiler goes into stand-by mode and waits until new command arise. In case of

power supply break-down the boiler will go into the same state of the unit before the interruption.

ATTENTION : *During the operation of the boiler when the door of the combustion chamber is opened, it is possible to observe smoke leakage through the transport auger tract as well as the fuel hopper. Because of these reasons the opening of that door is not recommended. The same processes could be observed at the transition periods – during spring and autumn seasons, when the chimney's draught is reduced due to high ambient temperature.*

COMMENTS:

- *At the period of fuel ignition an electrical heater is activated. The heater will be deactivated when the flue gas temperature reaches certain level, sensed by flue gas thermostat, mounted on the exhaust duct of the boiler;*
- *During the very first starting period of the unit it takes time to fill the auger volume with fuel. According to the settings of the unit the first ignition may fail. If this is the case, please restart the unit (by switching OFF and ON by the main POWER switch) and check the ignition process again;*
- *The boiler is operating, controlled by predefined algorithm, loaded in the process control module. The program itself is protected against unauthorized intrusion by a password. The user can change some unlocked and unprotected parameters. The meaning of any available parameter should be clear before any intervention and changes, otherwise the operating results are hardly predictable and malfunction could be caused;*

5.2.4. Main parameters for boiler operation.

The following table contains parameters, which define boiler's heat capacity.

Parameter	Description	Recommended value	Dimension
		Pelletherm 30v2 BIO	
T4	*Wood chips feeding time – during this period fuel is fed to the burner;*	*21.0*	*seconds*
T6	*Wood chips combustion time (fuel is not transported to the burner)*	*16.0*	*seconds*

Table 5.1. Description of the operating parameters, which define the thermal capacity of the automatic hot water boiler of series "Pelletherm 30v2 BIO" at nominal thermal capacity, utilizing **main fuel** - **dry calibrated wood chips**.

ATTENTION : *The producer guarantees effective and reliable operation of the boiler ONLY when its running conditions are in its corresponding operating range. That's why if any parameter is changed, it's value should be checked and verified to lie in the appropriate limits. Special care should be taken to fulfill the following requirements: the ratio of the described periods* **T4** *and* **T6 - (T4/T6)** *should be in the following range, when utilizing* ***main fuel*** *–* ***dry calibrated wood chips****:*

- *„Pelletherm 30v2 BIO":* $\frac{4}{16} = 0.25 =\leq \frac{T4}{T6} \leq \frac{21}{16} = 1.31$, *where* $\frac{4.0}{16} = 0.25$ *defines the* ***lower thermal capacity*** *of the boiler, corresponding to about 9kW, while the ratio* $\frac{21}{16} = 1.31$ *defines* ***the nominal thermal capacity*** *of the boiler, operating on* ***dry calibrated wood chips****;*

Parameter	Description	Recommended value	Dimension
		Pelletherm 30v2 BIO	
T4	*Wood pellets feeding time – during this period fuel is fed to the burner;*	*3.3*	*seconds*
T6	*Wood pellets combustion time (fuel is not transported to the burner)*	*16.0*	*seconds*

Table 5.2. Description of the operating parameters, which define the thermal capacity of the automatic hot water boiler of series "Pelletherm 30v2 BIO" at nominal thermal capacity, utilizing **secondary fuel** - **wood pellets**.

ATTENTION : *The producer guarantees effective and reliable operation of the boiler ONLY when its running conditions are in its corresponding operating range. That's why if any parameter is changed, it's value should be checked and verified to lie in the appropriate limits. Special care should be taken to fulfill the following requirements: the ratio of the described periods* **T4** *and* **T6 - (T4/T6)** *should be in the following range, when utilizing* ***secondary fuel*** *–****wood pellets:***

- *„Pelletherm 30v2 BIO":* $\frac{0.8}{16} = 0.05 =\leq \frac{T4}{T6} \leq \frac{3.3}{16} = 0.206$, *where* $\frac{0.8}{16} = 0.05$ *defines the* ***lower thermal capacity*** *of the boiler, corresponding to about 9kW, while the ratio* $\frac{3.3}{16} = 0.206$ *defines* ***the nominal thermal capacity*** *of the boiler, operating on* ***wood pellets****;*

NOTE: The choice of these parameters could be preceded as well as followed by other parameters, which are not described in the table above. These parameters are dedicated to be varied by authorized trained service personal and their variation by the end user is not recommended;

The following table contains main parameters, which are utilized to control the functionality of the boiler. Any changes of the parameter's values should be done in case that the meaning and the influence of a changed parameter is preliminary known. In case that a parameter's value should be changed, it is recommended to be done by trained authorized technician only.

Para meter	**Description**	**Recommended value** **Pelletherm 30v2 BIO**	**Dimension**
T1	*Period of time for conducting initial doze of dry wood chips to the burner*	*300*	*seconds*
T2	*Maximal period of time until stable combustion process is achieved*	*900*	*seconds*
*T4**	*Dry wood chips feeding time – during this period the fuel is fed to the burner –* ***determines the heat capacity of the unit****;*	*21.0*	*seconds*
T5	*Period of time for fuel combustion after STOP signal has been set*	*30m:00 s*	*minutes: seconds*
*T6**	*Wood chips not feeding time (fuel is not transported to the burner) -* ***determines the heat capacity of the unit****;*	*16.0*	*seconds*
T7	*Period of time for initial fuel doze combustion*	*100*	*seconds*
T9	*Period of time between two cleaning procedures.* ***ATTENTION :*** *change the value of the period only – tB*	*tA=00.02* *tB = 02.00 h:m*	*hours: minutes*
TB	*Period of time, which generates false hysteresis of the level of the fuel in the fuel hopper*	*60*	*seconds*
TC	*Period of time for fuel combustion before burner's ash cleaning mechanism actuation*	*400*	*seconds*
C	*Ignition attempts counter (C-1)* **(*EXPLANATION* :** *at C=4 the boiler makes 3 (three) ignition attempts);*	*4*	*count*

Table 5.3. Description of the control parameters, which define nominal operating mode of the hot water boiler of series "Pelletherm 30v2 BIO", utilizing **main fuel** – ***dry calibrated wood chips*****.**

Para meter	Description	Recommended value Pelletherm 30v2 BIO	Dimension
T1	*Period of time for conducting initial doze of wood pellets to the burner*	*150*	*seconds*
T2	*Maximal period of time until stable combustion process is achieved*	*900*	*seconds*
*T4**	*Wood pellets feeding time – during this period the fuel is fed to the burner –* ***determines the heat capacity of the unit****;*	*3.3*	*seconds*
T5	*Period of time for fuel combustion after STOP signal has been set*	*30m:00 s*	*minutes: seconds*
*T6**	*Wood pellets not feeding time (fuel is not transported to the burner) -* ***determines the heat capacity of the unit****;*	*16.0*	*seconds*
T7	*Period of time for initial fuel doze combustion*	*100*	*seconds*
T9	*Period of time between two cleaning procedures.* ***ATTENTION :*** *change the value of the period only – tB*	*tA=00.02* *tB = 02.00 h:m*	*hours: minutes*
TB	*Period of time, which generates false hysteresis of the level of the fuel in the fuel hopper*	*60*	*seconds*
TC	*Period of time for fuel combustion before burner's ash cleaning mechanism actuation*	*400*	*seconds*
C	*Ignition attempts counter (C-1)* **(*EXPLANATION* :** *at C=4 the boiler makes 3 (three) ignition attempts);*	*4*	*count*

Table 5.4. Description of the control parameters, which define nominal operating mode of the hot water boiler of series "Pelletherm 30v2 BIO", utilizing **secondary fuel –*wood pellets*.**

NOTES :

- In principal the fuel's ash content does not change its low calorific value. However, the combustion process is greatly influenced by the presence of mineral mass, i.e. ash, but requires specially designed burner in order to achieve efficient and reliable operation. The above mentioned requires appropriate testing and verification of the fuel's applicability as energy source for the automatic hot water boiler of series "Pelletherm 30v2 BIO" before making nominal exploitation of the unit. Consult the requirement for fuel of the boiler or request the appliance producer's assistance;
- The fuel moisture content significantly influences the fuel net calorific value.. In practice the fuel moisture content in the secondary fuel – wood pellets is changed in narrow range (between 6 up to 10%), which actually guarantees its stable and reliable properties. However, the moisture content of the **main fuel** – the **wood chips** varies and depends on the production process, their transportation method, as well as the storage conditions. The practice shows that in case the wood chips moisture content is increased, the overall efficiency of the heating unit is decreased, this also leads to increased pollutant emissions, released with the exhaust gases;
- The producer reserves the right to change the adjustment of the unit control module operating parameters without prior notice;
- The tables above contains factory default values for the parameters of the settings of the process control module, which lead to optimal unit adjustment and efficient boiler's operation;
- The described parameters : **T4** and **T6** are most frequently changed – they define the thermal capacity of the unit and its operating regime, considering the fuel type (**main fuel** – ***dry calibrated wood chips*** or **secondary fuel** – ***wood pellets***);
- The values of the main operating parameters – **T4** and **T6** are due to change, according to the type of the utilized fuel. In case the fuel type has been changed, the user should verify/change the values of the above mentioned parameters, considering the type of the new fuel. Not complying the operating parameter adjustment could result in boiler's alarm operating mode, which also decreases its lifetime and overall reliability;
- The automatic hot water boiler of series "Pelletherm 30v2 BIO" thermal capacity adjustment could be realized by weighting the fuel consumption rate (the mass of the fuel, transported to the specialized burner for predefined period of time), the fuel net calorific value and the boiler's overall efficiency should be considered as well. The following section describes the method :

- ***Weight the fuel consumption rate*** *(for one hour)- m_{wood_chips}=7.33 kg/h. Calculate the instant fuel consumption rate as follows : the instant fuel rate is divided by 3600 (1 hour = 3600 seconds) and the result is m'_{wood_chips} = 0.002036 kg/s;*
- ***Consider the fuel net calorific value*** *– H_{wood_chips} = 16.17 MJ/kg = 16000 kJ/kg. The practice shows that in some cases it is more convenient to utilize another dimension of the calorific value – kWh. The wood chips, complying with the automatic hot water boiler of series "Pelletherm 30v2 BIO" requirements, have calorific value of about 4.49 kWh/kg (which is equal to 16.17 MJ/kg);*
- ***The thermal efficiency is considered (stated by the producer)*** *at nominal thermal capacity - η_{boiler}=92.5%=0.925;*
- ***The thermal capacity of the boiler is calculated as follows*** *– use the boiler's efficiency, the fuel calorific value in [kJ/kg] and the instant fuel consumption rate, then calculate: $P_{boiler} = \eta_{boiler} * H_{wood\_chips} * m'_{wood\_chips} = 0.925 * 16170 * 0.002036 = 30.45\,kW.$ In case that the calorific value of the fuel is known in dimension kWh/kg, then the calculation is as follows $P_{boiler} = \eta_{boiler} * H'_{wood\_chips} * m''_{wood\_chips} = 0.925 * 4.49 * 7.33 = 30.44\ kW;$*
- *Any other thermal capacity of the boiler is calculated, following the described procedure above – for example if the fuel has different calorific value or the required thermal capacity is lower, than the nominal one;*

The producer reserves the right to make changes of the setting of the process control module without obligations to inform the clients for that process;

5.2.5. Adjustment process of the automatic hot boiler of series "Pelletherm 30v2 BIO" according to the thermal load of the building/consumer.

It is recommended to make appropriate adjustments of the process control module parameters in order to obtain high efficiency and reliable performance of the boiler, considering the thermal load that should be supplied by the boiler. The required heat capacity for heating purposes of a common house could be assumed to be a linear function of the **temperature gradient** ΔT (the difference between the mean value of temperature level in the heated rooms and the ambient temperature level). Thus the optimal operation process of the boiler requires regular adjustment of the "heat capacity" parameters of the unit.

EXPLANATION : the data, shown in the following table are calculated on the assumption that the mean temperature level in the heat supplied rooms of the

building is T_{room} =20[^{o}C]. If any other value is the case, than refer the temperature gradient instead.

NOTE : the value of the operating parameters T4 is determined, based on the assumption that the value of the operating parameter T6 is preserved constant;

$T_{ambient\ air}$	ΔT	Ratio T4/T6		T4		Thermal capacity	T6	
^{o}C	^{o}C	-		seconds		kW	seconds	
		Main fuel	*Wood pellets*	***Main fuel***	*Wood pellets*		***Main fuel***	*Wood pellets*
-15	35	1.312	0.206	21.0	3.3	30.0	16.0	16.0
-10	30	1.050	0.165	16.8	2.7	24.0		
-5	25	0.787	0.124	12.6	2.0	18.0		
0	20	0.250	0.050	4.0	0.8	9.0		

Table 5.5. Appropriate adjustments of "thermal capacity" parameters T4 and T6 according to the thermal load of the hot water boiler of series "Pelletherm 30 v2 BIO";

where :

T_{room} – mean value of the temperature in the heated rooms, [^{o}C];

$T_{ambient\ air}$ – mean value of the ambient temperature, [^{o}C];

$\Delta T = T_{room} - T_{ambient\ air}$ - temperature gradient, [^{o}C];

ATTENTION : In case that the boiler is working for heating purposes of domestic hot water ONLY, than the heat capacity of the unit should be considered the T4/T6 ratio limits as follows :

- *"Pelletherm 30v2 BIO" :* $\frac{T4}{T6} = 0.25$ *am utilizing* ***main fuel*** *–* ***dry calibrated wood chips*** *and* $\frac{T4}{T6} = 0.05$ *at utilizing the* ***secondary fuel – wood pellets****;*

COMMENT : *The above defined values of the "heat capacity" parameters are given for fuel, which complies with the fuel requirements, defined in the technical data table of the boiler. In case the fuel differs from the one described in the technical data table (for example its moisture content, dimension of the chipped particles, etc.) the operation parameters should be changed, but the requirements for reliable and safe unit operation must be fulfilled. However, one*

should check if the values of some of the other main operating parameters need adjustment– for example T1 or T9.

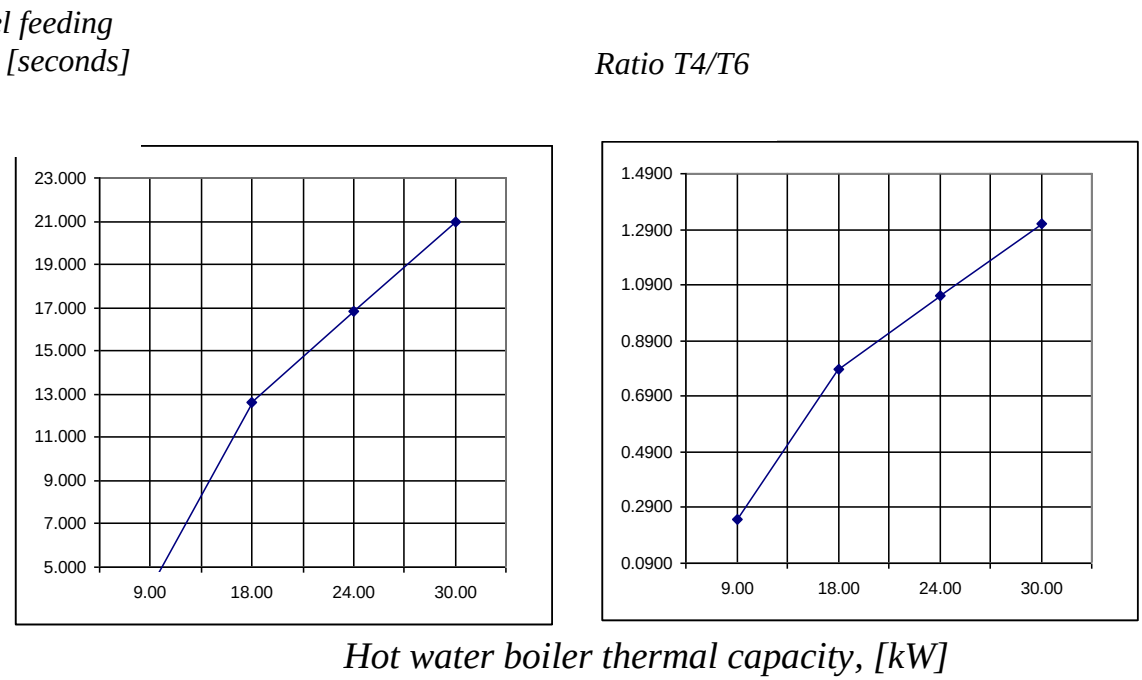


Figure 5.2. Graphics of the T4 parameter and power ratio (*fuel feeding time – T4 and ratio T4/T6*) values, according to the thermal capacity of the automatic hot water boiler "Pelletherm 30 v2 BIO" at utilizing **main fuel – *dry calibrated wood chips***;

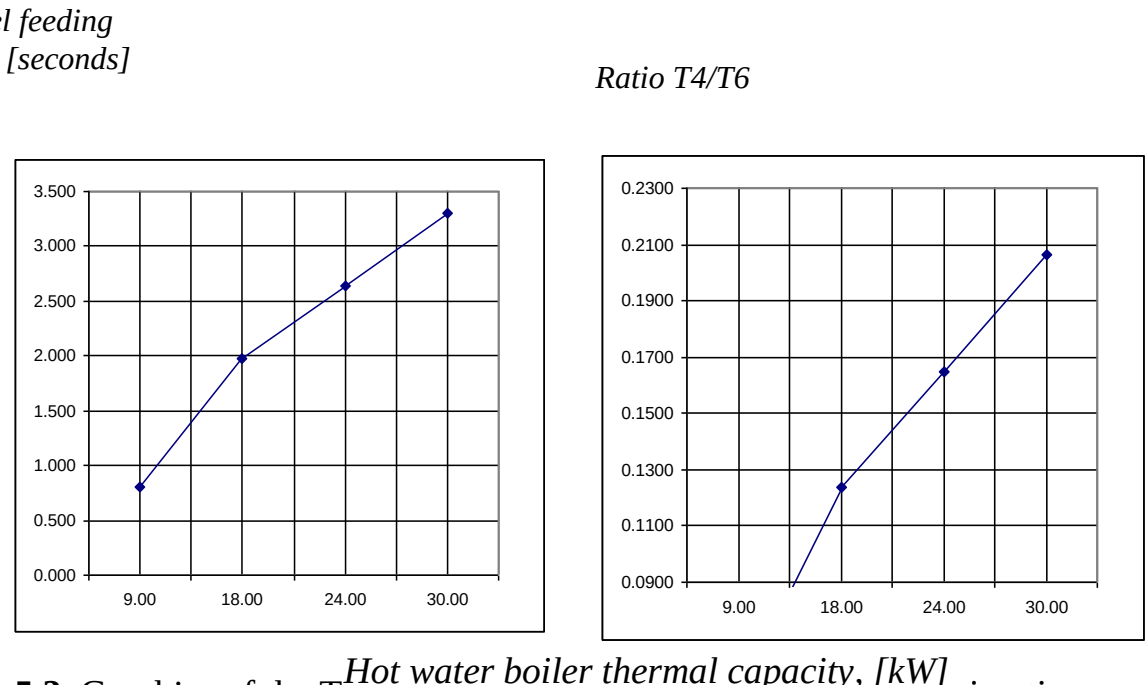


Figure 5.3. Graphics of the T[illegible]*ing time – T4 and ratio T4/T6*) values, according to the thermal capacity of the automatic hot water boiler "Pelletherm 30 v2 BIO" at utilizing **secondary fuel – *wood pellets***;

5.2.6. Changing the working parameters of the process control module.

Algorithm for changing the value of working parameters of the process control module of the boiler of series "Pelletherm 30v2 BIO":

The following text describes algorithm for changing the values of any parameter of the process control unit (**in case it is necessary !**). **It's recommended to change these parameters only when it is necessary. The physical meaning of any parameter should be clarified, as well as the influence of a parameter on the performance of the boiler**. The displayed parameters are allowed to be changed:

1. *Press the green button* (●), *marked* ***Menu/OK*** *on the interface panel of the process control unit. A menu list will be displayed;*

2. *Press buttons* ***arrow DOWN*** (▼) ***or UP*** (▲) *and choose the item* ***"PARAMETER";***

3. *Press button* ***arrow UP*** (▲) *until reaching the desired parameter –* ***T4*** *or* ***T6****;*

NOTE: *Do not try to change any other parameter, unless the meaning and the influence on the performance of the unit is now known a priory*;

4. *Press button* ***arrow RIGHT*** **(►)** *and choose the field of the parameter value;*

5. *Press button* ***arrow DOWN*** (▼) *or* ***UP*** (▲) *and change the value of the parameter.* ***Note:*** *Holding the buttons pressed* ***arrow DOWN(▼)*** *or* ***UP*** *(▲) after certain period will increase the increment of the change of the parameter's value;*

6. *After the desired value is defined, press the green button* ***Menu/OK;***

7. *The display of the process control module will show a question* ***"CONFIRM CHANGES?"****. Press buttons -* ***arrow DOWN*** (▼) ***or UP*** (▲) *until selecting the desired answer* ***"Yes"*** *or* ***"Not".*** *Choose the answer* ***"Yes"*** *by pressing the green button* ***Menu/OK****, in order to confirm the change, or answer* ***"Not"*** *in order to reject the change of the value of operating parameter*.

IMPORTANT! : *If the user is not confident in the necessity of the change of the value of any parameter, or the value of a parameter is changed accidentally, then it's recommended to choose the answer* ***"Not"****.*

8. *Press the green button **Menu/OK** once more time and the process control module will exit the "PARAMETER" mode and will display the nominal operation process of the boiler control.*

NOTE: *If any accidental change of a parameter has been made at the exit of this process a summary question will be displayed "CONFIRM CHANGES?" – choose the answer "**NO**" and any changes will be canceled.*

9. *Following the algorithm described above, one can change any available parameter of the process control module and can vary the setting and the performance of the boiler.*

NOTES:

- During the operating process of the boiler it is possible to arise an alarm situation (for example unsuccessful ignition process, fuel supply interruption, etc.). A short description of the alarm status is written on the display of the process control module. After removing the cause of the alarm situation, reset the operation module. The reset process of the unit is performed by switching OFF the main power supply switch and turning it back into ON position;

- At nominal operation process a manual ash residue removing process in the burner could be invoked by pressing the button ***arrow LEFT (◄)***. This option is dedicated for testing the performance of the cleaning module ONLY and should NOT be activated unless testing the cleaning mechanism is required. The automatic cleaning procedure is performed regularly in a predefined period of time (parameter T9 – *time period for automatic cleaning procedure*);

- The user should choose the menu item "PARAMETER". This submenu does not require password entry. However, the access to the service submenu items are password protected and are eligible by service technicians only;

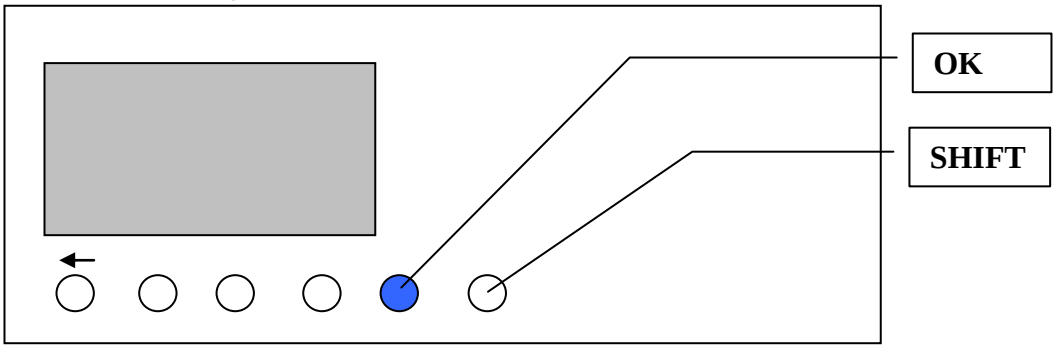


Figure 5.4. Front view of the hot water boiler main control module

For example, if the user tried to get into other submenu, like “MONITORING”, then the controller will expect password entry, as described on the following figure:

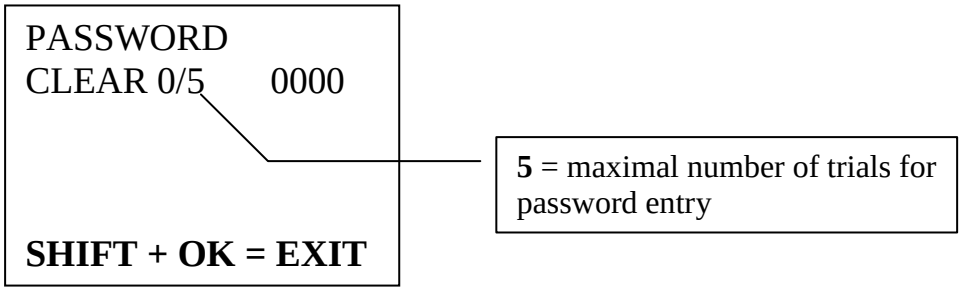
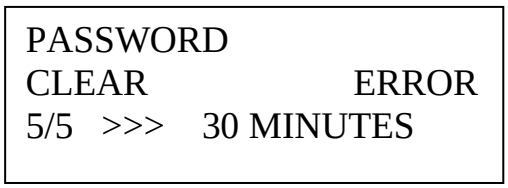


Figure 5.5. Example display, which shows the status of the submenu entry protection;

The way to exit such a menu is displayed – press simultaneously the buttons “SHIFT” and “OK”. The way to exit from the displayed submenu is to press the **left arrow button (◄).**

EXPLANATION : in case that the above described procedure is not followed, accidently the user could make up to 5 trials for password entry. After the user has made the above mentioned number of password entry trials, the display will state as depicted on the following figure:



Фигура 5.6. Information, shows on the control module’s display at reaching the password entry trials limit.

The above shown information indicates that password entry limit has been reached. The user should wait a period of 30 minutes at switched ON the power supply of the hot water boiler, until this protection times is reset. After passing the reset period (30 minutes) one should press the “SHIFT” and the “OK” simultaneously, the press the **left arrow button (◄)** button (follow the procedure described above). After passing the 30 minutes protection period, the control module protective timer set to 0 and one operate with the module.

EXPLANATION : The user can operate within the submenu “PRAMETER” ONLY.

5.2.7. Hot water boiler nominal operation mode.

After successful ignition of the fuel and when the operating temperature of circulating water is stable it could be assumed that the hot water heating boiler is in nominal thermal load. This mode should be utilized in order to make adjustments of the operating parameters of the unit. The parameters, described in **Table 5.1** and **Table 5.2** (and if necessary use the parameters, described in **Table 5.3** and **Table 5.4**) will define the thermal capacity of the boiler. After setting the values of operating parameters of the units, please check the position of the air flow rate adjustment flap of the air fan. The air flow rate is crucial for optimal operation and high efficiency combustion process, organized in the combustion chamber of the boiler.

The nominal thermal capacity of the units should be utilized in order to perform the so called "hot test" – check the entire heating system according to the acting norms for an operating heating system (for example check for any circulating water leakages).

NOTES :

- During the nominal thermal load of the boiler regular cleaning process is activated and the ash residue remained on the grate of the burner is removed away and is deposited in the ash container, positioned on the bottom of the combustion chamber. It should be noted that before the ash removal process, the fuel delivery to the burner is paused, while the air fan is working, thus ensuring conditions for utilization of the char, remained on the grate of the burner. A decrease of the thermal capacity of the boiler could be noticed however. **Comment :** *the period of ash removal of the grate plate of the burner is defined by the value of parameter T9, which is described in* ***Table 5.3*** *and* ***Table 5.4*** *for the appropriate type of fuel. During the automatic ash cleaning interval a temporal decrease of the thermal capacity of the boiler is observed*;
- If a circulating pump is installed in order to transport the heat energy of the boiler to the consumers, it is recommended to control the inflow temperature to the boiler to be above 60^{o}C. In case of low inflow temperature level, condensation of water vapor could be observed on the internal heat exchanging surfaces (please consider that water vapor is one of the final products of the combustion process and always persist in the flue gases of the boiler);
- It is not recommended to operate the hot water boiler at thermal capacity lower than the minimal thermal load, as such regimes are not optimal and thus have low efficiency of the unit;

- In case that continuous operation in low thermal load regimes are required, then it is recommended to connect heat accumulator to the heating system, which will ensure high efficiency, economical and reliable operation of the boiler itself, and the entire heating system in general;
- During the very first time of operation the boiler it is possible to observe water vapor condensation on the heat exchanging surfaces of the unit. Practically this is one-time process and will not affect the performance of the unit, neither any problems will arise as well;

ATTENTION : *The air flow rate is crucial for optimal operation of the combustion process, organized in the burner and the boiler overall operation effectiveness – when the air flow rate is less than the optimal one, then this insufficiency will result in incomplete combustion of the fuel, as the supplied oxygen is less than required. When the air flow rate is higher than optimal the result will be unsatisfying as well, because the excessive air will lead to low temperatures in volume for controlled combustion and will result in incomplete combustion of the fuel's volatile gases, released by the combustion process.*

That's why it is recommended to use specialized device – ***gas-analyzer*** *in order to adjust the operating parameters of the control module and to optimize the boiler's performance, thus achieving high efficiency and economical operation of the unit.*

5.3. Adjustment of the thermal capacity of the boiler.

The adjustment of the thermal capacity of the boiler is performed by simultaneous adjustment of the fuel flow rate and the air flow rate, supplied by a fan to the burner.

The adjustment of the fuel flow rate is controlled by so called "thermal capacity" parameters (**T4** – *fuel feeding time at nominal thermal capacity and* **T6** – *fuel combustion period, i.e. period of time, when fuel is not fed to the burner*), which will determine the thermal capacity of the boiler, according to the utilized type of fuel (**main fuel** – ***dry calibrated wood chips*** and **secondary fuel** – ***wood pellets***).

ATTENTION: *In case of change of the fuel type (for example switching from* ***main fuel*** *to* ***secondary fuel****) it should be followed by adjustment of the thermal capacity parameters and the operating mode of the boiler.*

5.3.1. Decreasing the thermal capacity of the boiler:

It is realized by decreasing the value of parameter **T4**, which will result in decreasing the fuel flow rate (fuel consumption). The same result

(decreasing the thermal capacity) is achieved by increasing the value of parameter **T6.** The air flow rate should be decreased proportionally.

5.3.2. Increasing the thermal capacity of the boiler :

It is realized by increasing the value of parameter **T4**, which will result in increasing the fuel flow rate (fuel consumption). The same result (increasing the thermal capacity) is achieved by decreasing the value of parameter **T6.** The air flow rate should be increased proportionally.

ATTENTION :

- *Adjustment of the "thermal capacity" parameters should be performed by trained personal/end user, in order to achieve high efficient combustion process and optimal utilization of the fuel energy. The air flow rate decrease is performed by closing the air flow rate control flap, installed on the air fan entrance section, while the air flow rate increase is performed by opening the above mentioned flap. Also the user should* ***pay attention*** *especially when the fuel type changes – for example switching from* ***main fuel*** *–* ***dry calibrated wood chips*** *to* ***secondary fuel*** *–* ***wood pellets****, because the above two fuel types have different net calorific value.* ***It is highly recommended to perform the boiler's thermal capacity by authorized trained technician, using gas analyziser****;*
- *In case of change of "heat capacity" parameters (T4 and T6), it should be determined the ratio T4/T6 in order to verify that this ratio is in the range of the limits, described in* ***Table 5.1, 5.2, 5.3.*** *or* ***5.4 for the appropriate fuel type****. In case that the ratio T4/T6 exceeds the operating interval, one of the parameters (T4 or T6) should be changed in order to comply the requirements and the ratio is in the operating range (again pay attention to comply with the ratio requirements for the type of fuel –* ***main fuel*** *or* ***secondary one*** *);*
- *It is recommended to change the value of one of the thermal capacity parameters –T4;*

5.4. Stopping the operation of automatic hot water boiler.

Stopping the operation of the boiler should be performed by turning OFF the "START" switch, mounted on the interface panel of the unit. Respectively, the starting process will be invoked by turning "START" switch in ON position. In case that the boiler will not operate for a relatively short period of time, than it is recommended to clean the ash deposited on the easy accessed heating surfaces of the heat exchanger.

ATTENTION : *In case that the boiler will not operate for a long period of time, then the heat exchanger should be thoroughly cleaned from the deposited ash. The deposited on the metal surfaces ash acts corrosively on the carbon steel surfaces, which will lead to a decrease of the lifetime of the boiler's main modules – heat exchanger, as well as the burner. It is obligatory to perform service procedures and preventive observations of the unit by trained service personal only as well as thorough cleaning at the end of the heating season. Completing these requirements will ensure long exploitation time of the boiler and its high efficiency and reliability.*

5.5. Turning OFF the boiler.

ATTENTION : *The shutdown of the equipment is done by returning the switch "START" in position - "OFF". This is the recommended way of shutdown, as is done etc. "controlled shutdown", during which the relevant fans work and the emergency signals by the boiler's controller are monitored. After cooling, the boiler must be switched off using the switch "POWER", located on the control panel of the equipment. Is it also recommended that the equipment to be cleaned of the deposited ash.*

<u>It is forbidden to stop the boiler through the "POWER" switch at work!</u>

- **Emergency boiler stop.**

  In operating process of the boiler emergency situations could arise and the boiler will go into alarm/failure mode. Some situations are detected by the process control module and it will go into automatic preventive regimes in order to protect the boiler and the heating system. These regimes are operated by appropriate automatic preventive measures as well as the control module display shows a short informative text, describing the cause of the alarm state and the "ALARM" lamp is indicating the state of the boiler. Please refer the informative text on the control module's display before taking any actions. After the cause of the alarm situation is clarified, take adequate actions for bringing back the boiler into normal operating conditions and restart the boiler by switching it OFF and back into ON state by turning the main "POWER" switch.

ATTENTION : *in case of emergency situation – **boiler overheating**, the emergency thermostat is activated, appropriate text is displayed on the control module's display as well as indicator lamp is lit. In this case the boiler should be cooled down and the reason for such excessive process should be investigated and preventive measures should be performed. The emergency thermostat should be manually reset by unscrewing its preventive cap and its*

stem should be pressed until the thermostat switches back on (a "click" sound is heard in this process), screw the cap back. After the boiler is checked and the cause for overheating is determined and repaired, restart the control operation module by turning OFF the main "POWER" switch and then back ON in order to operate the boiler in normal operation mode.

5.6. Showing and teaching the end user about the maintenance and adjustment procedures.

It is necessary to show and teach the end user the maintenance procedures for operating the boiler efficiently and keep its reliability in high degree order. Also the installer should demonstrate and teach the end user how to change the operating parameters of the control module of the boiler in order to operate the unit in different modes and heat capacities, according to the local heat consumption:

- **Boiler's fuel hopper charging** – горивото се изсипва в бункера на котела, след което трябва да се затвори капака на този бункер, за да се ограничи навлизането на неорганизиран въздух през този модул от котела. В случай, че в системата е монтиран външен шнек за зареждане на бункера с гориво, то тогава външният бункер, от който този шнек отнема горивото трябва да бъде зареден, трябва да бъде запълнен шнека с гориво и да се провери работата на системата за автоматично зареждане с гориво;
- **External main fuel hopper charging** – the hopper for dry calibrated wood chips – the fuel particles should be poured in the hopper, after that the fuel should be smoothly spread in order to optimally utilize the hopper capacity. The external fuel transport auger (which extracts the fuel from this hopper and transports the chips to the boiler's hopper) should also be filled with chips, the entire fuel storage and automatic transport system should be carefully checked;
- **Ash cleaning procedure** – it is recommended to clean periodically the ash residue (at least once per day) the convective heat exchanger part of the unit by manually swinging the cleaning lever for semiautomatic ash cleaning process. Covering this requirement will ensure effective heat exchanging process and will sustain optimal operating conditions of the boiler. Detailed ash cleaning and maintenance procedures are described in **ANNEX 1** of this manual*;*

5.7. Safety and unexpected risks

Risks could arise at the exploitation of the boiler:

The automatic hot water boiler of series "Pelletherm 30v2 BIO" is designed according to the safety requirements of the operating European standards and norms. However safety and unexpected risks could arise in situations like following:

- *The automatic hot water boiler of series "Pelletherm 30v2 BIO" is operating incorrectly;*
- *The unit is installed by unauthorized/unqualified personal;*
- *The safety instructions, described in this manual are not followed and fulfilled;*

Unexpected risks:

The unit is designed and produced according to the requirements of the operating EU safety norms. However, in spite of that possible risks are considered as a result of the operating process of the boiler, it is possible to get risks as follows:

- ***Cauterization risks**, caused by high temperatures, as a result of the combustion process in the combustion chamber and/or direct access to the front door of the combustion chamber, at manual cleaning processes of the surfaces of the burner and/or combustion chamber, or ash residue cleaning, accumulated in the ash tray or any unburned fuel material, smoldering in the ash tray;*

- ***Electrical shock risks** at indirect contact. The boiler is connected to the power circuit and its operating modules are separated in specialized electric control box, equipped with required protective and short-circuit preventive devices. It is obligatory to perform boiler ground connection by authorized personal/technician.*

- ***Fingers injuring risks** at opening/closing the doors/caps of the boiler at maintenance and cleaning process of the unit. It is recommended to use appropriate individual resources for self-protection;*

- ***Suffocation risks** due to flue gas uncontrolled emissions in the boiler's room, in case when the chimney draught is insufficient, in case that the convective part of the boiler is clogged, or in case that the flue gas duct is not fully tightened and gas leaks are possible;*

5.8. Operation faults and their repairing

No	Operation fault	Cause	Method for repairing

1.	Low temperatures in the heat supplied rooms	Insufficient heat capacity	Adjustment of operating parameters is required – *this should be performed by authorized technician*
		Low set-point temperature of the boiler's operating thermostat	It is necessary to increase the set-point of the boiler's operating thermostat (up to 90^{o}C)
		Low set-point temperature of the remote room thermostat (if connected)	It is necessary to increase the set-point of the room thermostat
2.	High temperatures in the heat supplied rooms	High set-point temperature of the boiler's operating thermostat	It is necessary to decrease the set-point of the boiler's operating thermostat (it is recommended to keep it above 60^{o}C)
		High set-point temperature of the remote room thermostat (if connected)	It is necessary to decrease the set-point of the room thermostat
3.	The boiler is active, but no combustion process	"START" signal is not present	It is necessary to check the status of the operation signal of any of the following : room thermostat, "START" switch, boiler's operating thermostat
4.	Difficult fuel ignition	Low quality fuel or its properties does not comply with the requirements	It is necessary to replace the fuel, most probably due to its high moisture content, which could be above the required value for nominal operation of the boiler – *it is recommended to consult the unit maintenance company*;
5.	Boiler's emergency overheating	Absence of heat consumption or incorrect adjustment of the parameters of the boiler or poor operation of the heating installation	It is necessary to check the correct operation process of the heating installation and eventually appropriate adjustment of the operating parameters of the boiler and/or control valves of the installation – *this should be performed by authorized technician*. After the

			boiler is cooled down to ambient temperature and the reason for boiler overheating is serviced out, the protective cap of the emergency overheating thermostat should be unscrewed, its rod should be pressed until the thermostat is reset and it's cap should be screwed back. The main "POWER" switch is turned OFF and back ON afterwards and the boiler is thus restarted.
6.	No fuel ignition	Absence of fuel in the hopper	The fuel hopper should be charged. The boiler's operation should be restarted.
		Absence of fuel in the burner	It is possible to manually restart the operation process of the boiler. This way the ignition process could be elongated. If this approach results in stable ignition, then it is necessary to increase the value of the initial fuel mass - parameter T1, described in Table 5.3 and Table 5.4 (*the change of that parameters is recommended to be made by authorized technician*), considering the type of the fuel the adjustment should be performed by authorized technician.
		Fuel is present in the burner, but it's not ignited or it is fully incinerated and the combustion process has extinguished, i.e. not present;	In case that the electrical heater is out of order or not operating, then it should be replaced with appropriate working one. In case that the heater is working, then it is necessary to increase the time for ignition of the initial mass of the fuel - *parameter T2, described in Table 5.3 or Table 5.4. - the adjustment should be performed by authorized technician*;

		Abnormal operation or malfunctioning of the flue gas thermostat	The flue gas thermostat should be adjusted or replaced in case it is out of order
7.	The flame looks "opaque" and smoke is observed at the exit of the chimney	Low quality fuel, or the fuel does not comply with the requirements	Fuel replacement is recommended, most probably the moisture content is higher than required;
		Inappropriate operating parameters adjustment	It is necessary to perform adjustment of the operating parameters of the unit and achieve efficient combustion process - *the adjustment should be performed by authorized technician*;
8.	Presence of unburned fuel in the ash tray	Ineffective fuel combustion process	It is necessary to perform adjustment of the operating parameters and the air flow rate – *the adjustment should be performed by authorized technician*;
9.	Alarm – absence of ash cleaning	A problem in ash cleaning module	It is necessary to contact the service company and help of a authorized technician is required;
10.	High temperature of the flue gases (if flue gas thermometer is mounted)	The heat exchanging surfaces of the boiler are deposited with ash, presenting heat resistive layer, thus decreasing the heat exchanging intensity	It is necessary to clean thoroughly the heat exchanger surfaces of the boiler;
11.	Water vapor condensates on the surfaces of the combustion chamber	Low temperature of the inlet water flow	It is necessary to perform adjustment of set-point temperature, which controls the circulating pump of the heating system. It is recommended to adjust the thermostat set-point to minimum of $65^{o}C$;
12.	Flue gases are emitted out in the boiler's room after certain period of	The flue gas fan is clogged or even blocked by fly ash deposits	It is necessary to clean thoroughly the flue gas fan and its casing – *this should be done by authorized technician;*
		Incomplete tightness	It is necessary to perform

	exploitation	of the combustion chamber's door or/and other flue gas duct	adjustment and tightening of the combustion chamber's door, as well as any other lids, eventually change the heat resistant ropes – *this should be performed by authorized technician only*
13.	The fuel transport mechanism is not functioning	The door of the fuel hopper section is opened	The door's safety switch is active – this door should be closed
		The door of the fuel hopper section is closed, but the fuel transport auger is not functioning	The fuel transport mechanism should be checked – *this should be performed by authorized technician only*
14.	Other failures, not described above		It is necessary to consult authorized technician and eventually service maintenance should be performed

Таблица 5.5 Description of operation faults of the hot water boiler of series "Pelletherm 30v2 BIO", causes and methods for repairing.

5.9. Hot water boiler warranty form completion.

The applied WARRANTY FORM should be completed, by filling the required information in the appropriate fields. The assigned field for signatures and stamp should be completed as well in order to VALIDATE the WARRANY FORM of the unit.

5.10. Actions, after the unit is not in exploitation anymore.

After the lifetime period of the unit has been completed, then it should be treated properly in order to preserve environment contamination. The unit should be dismounted and disassembled by environmentally safe methods. This requirement is most commonly completed by appropriate components recycling, considering separate waste disposal and utilization methods.

6. Electrical scheme of automatic hot water boiler of series “Pelletherm 30v2 BIO”.

Figure 6.1 and Figure 6.2 show electrical scheme of the automatic hot water boiler of series “Pelletherm 30v2 BIO”.

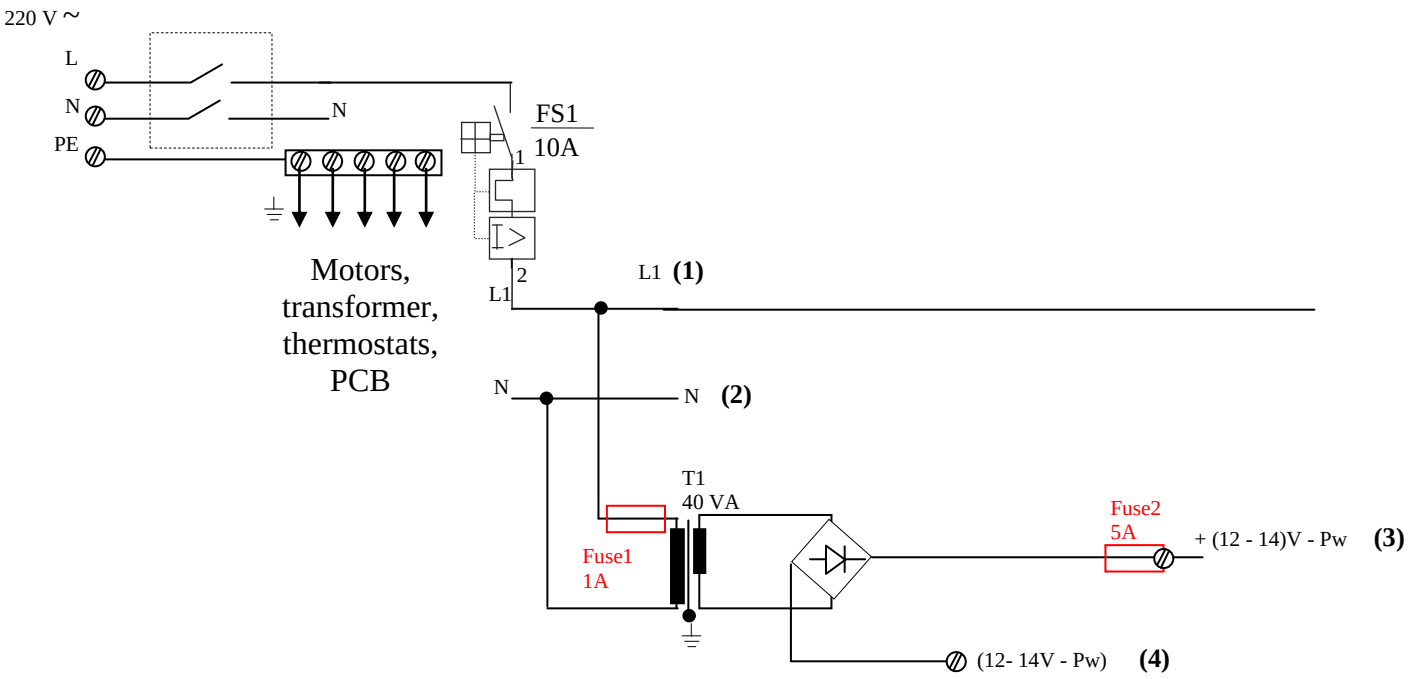


Figure 6.1 Electrical scheme for connecting the automatic hot water boiler of series “Pelletherm 30v2 BIO” to the main power supply;

I1 – input flame sensor
I3 – Start
I6 – back fire in auger (option)
I8 – pellet level-capacitive sensor
IB - Actuator-Potentiometer

T ^{0}A – alarm thermostat H_2O
T ^{0}W- boiler thermostat H_2O
T ^{0}R - room thermostat
T ^{0}FL - thermostat flue gas

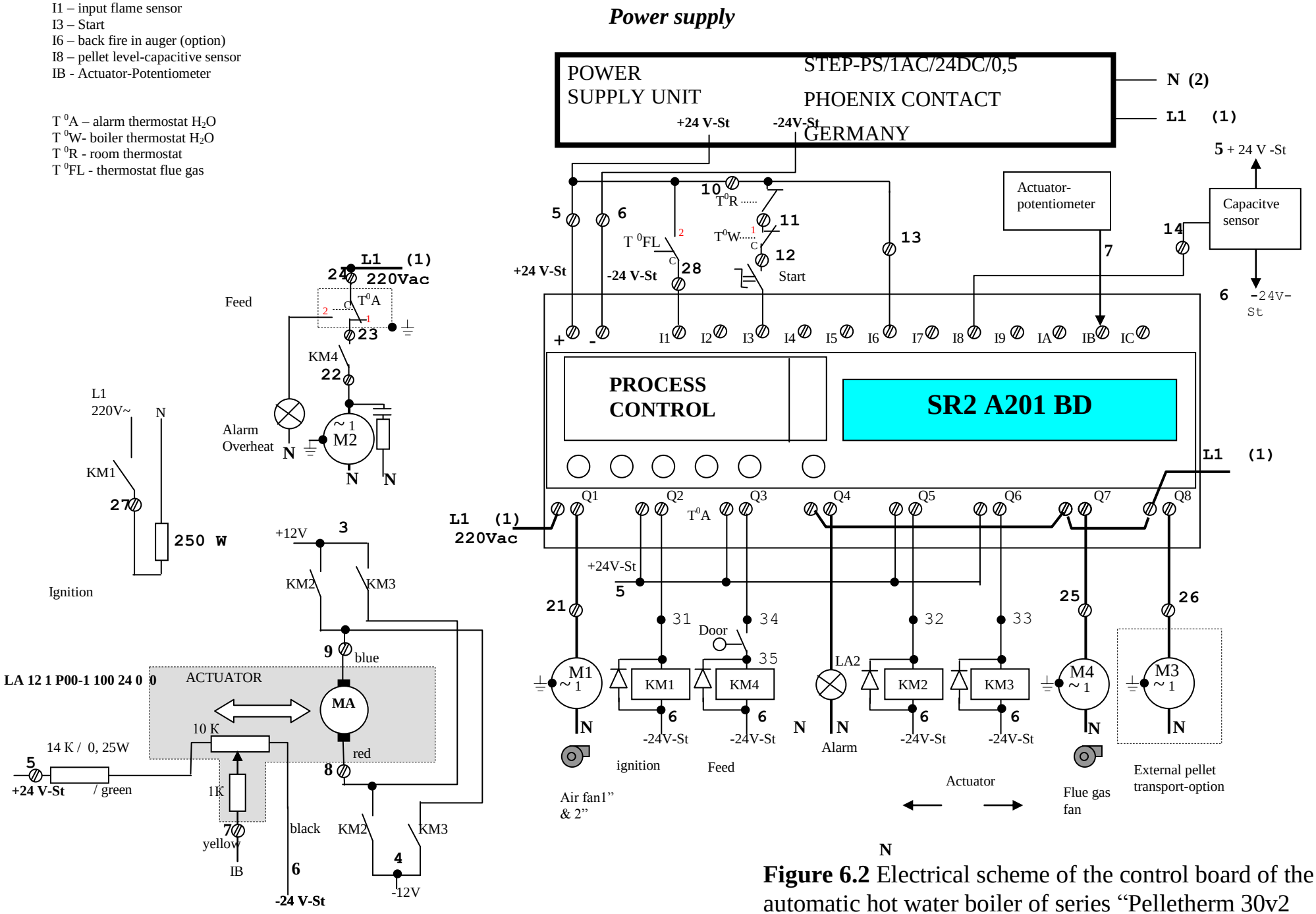


Figure 6.2 Electrical scheme of the control board of the automatic hot water boiler of series "Pelletherm 30v2

WARRANTY CONDITIONS

The producer guarantees correct and reliable operation of the unit ONLY when installation and maintenance requirements are completed.

The warranty period of the boiler starts from date, when the warranty form is filled and stamped by the authorized organization.

THE WARRANTY OF THE UNIT IS NOT VALID in case one of the following is fulfilled:

- Unit damages, caused by incorrect handling, transport and/or loading/unloading, which are not organized by the producer;
- Failures, caused by natural disasters (Earth quakes, fires, floods, etc.);
- Unsatisfied installation, maintenance and service requirements, which are described in this manual and its annex;
- Repairing of any failure of the unit, performed by unauthorized technicians or the end user;
- Any changes in the design of the boiler;
- Incorrect heating system project (design) and implementation;
- Failures, caused by factors, for which the producer could not be blamed and/or has no control over them;
- Any malfunctions or damages, which are not caused by the operation of the boiler itself, but result in unit damages and its functionality;

Every warranty service operation should be noticed in its warranty service procedures list.

The warranty period of the unit is interrupted by the period, during which the unit is warranty serviced by authorized technicians (the period between failure notification and its repairing).

The warranty period of the unit is **24** months.

The warranty of the unit is valid when the original invoice document and the original warranty form are presented only.